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ENGINEER DEPARTMENT, UNITED STATES ARMY.

REPORT

UPON

GEOGRAPHICAL AND GEOLOGICAL

EXPLORATIONS AND SURVEYS

WEST OF THE ONE HUNDREDTH MERIDIAN,

IN CHARGE OF

FIRST LIEUT. GEO. M. WHEELER,
CORPS OF ENGINEERS, U. S. ARMY,

UNDER THE DIRECTION OF

BRIG. GEN. A. A. HUMPHREYS,
CHIEF OF ENGINEERS, U. S. ARMY.

PUBLISHED BY AUTHORITY OF HON. WM. W. BELKNAP, SECRETARY OF WAR,

IN ACCORDANCE WITH ACTS OF CONGRESS OF JUNE 23, 1874, AND FEBRUARY 15, 1875.

IN SIX VOLUMES, ACCOMPANIED BY ONE TOPOGRAPHICAL AND ONE GEOLOGICAL ATLAS.

VOL. V.—ZOOLOGY.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1875.

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30 JUNE 1915

FORTY-THIRD CONGRESS, FIRST SESSION.

CHAPTER 455.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, for the objects hereinafter expressed, for the fiscal year ending June thirtieth, eighteen hundred and seventy-five, namely:

* * * * * * *

For engraving and printing the plates illustrating the report of the geographical and geological explorations and surveys west of the one hundredth meridian, to be published in quarto form, the printing and binding to be done at the Government Printing-Office, twenty-five thousand thousand.

* * * * * * *

Approved June 23, 1874.

FORTY-THIRD CONGRESS, SECOND SESSION.

CHAPTER 76.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act entitled "An act making appropriations for sundry civil expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and seventy-five, and for other purposes," approved June twenty-third, eighteen hundred and seventy-four, be, and the same is hereby, amended by adding to the clause of said act relating to the engraving and printing of the plates illustrating the report of the geographical and geological explorations and surveys west of the one hundredth meridian, the following words: and "that two thousand copies of the report shall be printed by the Congressional Printer," after substituting the word "dollars" in lieu of the concluding word of said clause.

Approved February 15, 1875.

NOTE.

Six volumes, accompanied by one topographical and one geological atlas, embrace Reports of Explorations and Surveys West of the One hundredth Meridian up to the close of the field-season of 1873, (excepting Volume V, which embodies results up to 1874,) as follows:—

Volume I.—Geographical Report.

Volume II.—Astronomy and Meteorology, including Barometric Altitudes.

Volume III.—Geology and Mineralogy.

Volume IV.—Paleontology.

Volume V.—Zoölogy.

Volume VI.—Botany.

An advance edition of the Topographical Atlas, consisting of Title-Page, Legend-Sheet, Index, Progress and Basin Maps, and sheets Nos. 49, 50, 57, 58, 59, 65, 66, and 67, was issued in 1874; other sheets will follow as rapidly as they can be prepared, engraved, and printed. The maps from the field-work of 1873 and subsequent years will be projected upon a scale of one inch to four miles. Sheets of a geological atlas, to supplement Volume III, based upon the topographical results, advance toward completion.

Addenda Note.—Lieutenant Wheeler, in his Annual Report for 1875, recommends an additional volume, to be numbered VII, and to be devoted to the subjects of Ethnology, Philology, and Ruins.

GEOGRAPHICAL AND GEOLOGICAL EXPLORATIONS AND SURVEYS WEST OF THE ONE HUNDREDTH MERIDIAN, FIRST LIEUT. GEO. M. WHEELER, CORPS OF ENGINEERS, U. S. ARMY, IN CHARGE.

REPORTS

UPON

THE ZOOLOGICAL COLLECTIONS OBTAINED FROM PORTIONS OF NEVADA, UTAH, CALIFORNIA, COLORADO, NEW MEXICO, AND ARIZONA,

DURING

THE YEARS 1871, 1872, 1873, AND 1874.

BY

H. C. YARROW, A. A. Surgeon U. S. Army, Surgeon and Zoölogist to the Expeditions of 1872 and 1874.

H. W. HENSHAW, Ornithologist to Expeditions of 1872-'73-'74.

Prof. E. D. COPE, Paleontologist to Expedition of 1874.

AND THE FOLLOWING SCIENTISTS:

ELLIOTT COUES, Assistant Surgeon U. S. Army, Surgeon and Naturalist to the Northern Boundary Commission.

E. T. CRESSON, of the American Entomological Society, Philadelphia.

EDWARD NORTON, Farmington, Conn.

THEO. L. MEAD, of Cornell University, Ithaca, N. Y.

WM. H. EDWARDS, Coalburgh, West Va.

RICH'D H. STRETCH, San Francisco, Cal.

C. R. OSTEN-SACKEN, Museum of Comparative Zoology, Cambridge, Mass.

HENRY ULKE, Washington, D. C.

Prof. P. R. UHLER, Peabody Institute, Baltimore, Md.

Prof. CYRUS THOMAS, State Entomologist, Carbondale, Ill.

Dr. H. A. HAGEN, Museum of Comparative Zoölogy, Cambridge, Mass.

Prof. A. E. VERRILL, Yale College, New Haven, Conn.

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The plates illustrating this volume were engraved and printed by Messrs. Thos. Sinclair & Son, of Philadelphia. The bird plates were drawn from nature by Mr. Robert Ridgway, of the Smithsonian Institution.

LETTER OF TRANSMITTAL.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL EXPLORATIONS AND SURVEYS
WEST OF THE ONE HUNDREDTH MERIDIAN,
Washington, D. C., February 5, 1875.

GENERAL: I have the honor to transmit herewith a report based upon the results of the examinations of the collections in zoölogy, made by the several field parties of the survey during the years 1871 to 1874, inclusive.

In the examination and identification of these collections, several gentlemen, eminent in this branch of scientific investigation, have cheerfully rendered valuable assistance, and their reports, together with those by members of the survey, constitute the subject-matter of this volume.

The general collation of the data and supervision for publication has been intrusted to Acting Assistant Surgeon H. C. Yarrow, United States Army, in addition to his duties as medical officer during and since 1872, in which he has manifested commendable energy.

Skilled assistance in this branch was had for the first time in the expedition of 1871; the services of Acting Assistant Surgeon W. J. Hoffman, United States Army, by detail through the Medical Department, and of Mr. Ferdinand Bischoff, having been secured.

In 1872, Acting Assistant Surgeon H. C. Yarrow, United States Army, with the assistance of Mr. H. W. Henshaw, and incidentally of other members of the expedition, accomplished most satisfactory results.

In 1873, the force was further augmented by the services of Acting Assistant Surgeons J. T. Rothrock and C. G. Newberry, United States Army, and Mr. John Wolf, collector.

The field operations of the survey require the services of medical officers in their professional capacity, yet not to such an extent as to preclude their availability for labor in other directions, hence their assignment to investigations in the important branches of zoölogy.

In an organization formed for exact geographical purposes, the auxiliary branches must of need be secondary to the main object; still, it is believed that this report will meet all just expectations, especially when the dependency under which the material was obtained and the limited additional expense incurred are considered.

The collections made have generally been large, and include a fair proportion of new and rare specimens. Many of them have been forwarded to the Smithsonian Institution, and a number of crania and osteological specimens have been collected for the Army Medical Museum.

The services of the gentlemen whose analytical reports are herewith, and of the officers of the Army who have rendered valuable assistance to the field parties, are gratefully acknowledged.

To Brig. Gen. M. C. Meigs, Quartermaster-General United States Army, who has so fully sympathized with the objects of the survey, thanks are due.

The active and hearty co-operation of the Medical Department, for which much is due to Surgeon-General J. K. Barnes and Assistant Surgeon-General C. H. Crane, in supplying medical officers with tastes for natural history work, has conduced largely to the gratifying results obtained.

For want of space, the final Botanical Report has been excluded, and will appear separately as Volume VI, embracing results to the date of its issue.

The accumulating material in the subjects of Ethnology, Philology, and Ruins will, as time and means permit, be consolidated into a separate report, with appropriate illustrations.

In conclusion, I beg to express my hearty appreciation of the services of the professional gentlemen who have been engaged in this field of research.

Very respectfully, your obedient servant,

GEO. M. WHEELER,
Lieutenant of Engineers, in Charge.

Brig. Gen. A. A. HUMPHREYS,
Chief of Engineers, United States Army.

INTRODUCTORY LETTER.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL EXPLORATIONS AND SURVEYS
WEST OF THE ONE HUNDREDTH MERIDIAN,
Washington, D. C., February 1, 1875.

SIR: The following brief statement of the operations of the zoölogical work of the expedition for the years 1871, 1872, 1873, and 1874, based upon the collections made by different members of the party in this period, and embracing an epitomized account of certain portions of the different Territories visited by the collectors, may prove of interest, besides assisting in giving an idea of the features of the several regions as regards geographical distribution.

Although the active operations of the expedition were inaugurated in 1869, owing to various circumstances it was not until 1871 that facilities adequate to a proper prosecution of natural history work, as an item of interest collateral to the special object of the survey, topography, were available. Anticipating at this time that the country through which the expedition must pass, being but little known and seldom visited, would prove a rich field for the study of the naturalist in developing the existence of many forms of animal and vegetable life, rare, if not new, to science, the services of Acting Assistant Surgeon W. J. Hoffman, United States Army, were secured, together with those of Mr. F. Bischoff, a collector of recognized skill and enthusiasm, to whom was confided the task of collecting.

The points of departure in 1871 were: Carlin and Battle Mountain, Nev., on the Central Pacific Railroad; the point of disbandment, Tucson, Arizona; the area between these places extending about eight degrees in latitude, and longitudinally from the 110th to the 119th degree.

The several rendezvous were: Belmont, Nev.; Camp Independence, Cal.; Cottonwood Springs, Nev.; Crossing of the Colorado River, Truxton Springs, Prescott, and Camp Apache, Arizona.

The expedition being divided, a collector was assigned to each of the main parties, who diverged therefrom in the vicinity of the rendezvous camps and other desirable points along the line of travel. In this way, facility was also afforded for visiting portions of Nevada, California, and Utah, which were minutely examined; special attention being paid to the areas in basins of drainage of large parts of the several interior basins, as Owens River, Death Valley, Amargosa Desert, Las Vegas Valley, valleys of the Muddy and Rio Virgen, southeastern edges of the San Francisco Plateau, Verde and Salt Rivers, and Rio Gila. The map of the region in question, however, affords a more graphic as well as a better explanation of the localities visited than would any written description.

The reports on the parts of the collection which were received show that the regions visited are possessed of great interest to the student of natural history, and with the study of the specimens themselves can hardly fail to extend greatly our knowledge of the range of the fauna and flora of North America.

It is to be regretted that the great fire in Chicago left but few of the specimens gathered; those that remain, however, suffice to attest the reputation for zeal and industry of the gentlemen by whom the collection was made, and are abundant evidence to warrant the belief that the collection entire must have been extremely interesting.

Confident, perhaps, of the recent universally marked increase in attention to this branch of natural science, and of the great enthusiasm being manifested by foreign governments in kindred researches, and, perchance, not unmindful of the necessity for increased knowledge of our own fauna and flora, for the proper study of the fauna and flora of other lands, and that to this end specimens were necessary for comparison to establish the degrees of resemblance which exist between different bodies, in 1872 every facility practicable was afforded.

In 1872, the natural history branch of the survey was placed in my charge, with Mr. H. W. Henshaw, as assistant. The expedition was organized at Salt Lake City, where investigations were made in regard to the natural history of the vicinity of Great Salt Lake.

From this point, Mr. Henshaw and myself proceeded south fifty miles

to Provo, Utah, where two weeks were most profitably spent in the vicinity of the city, the cañons of the Wahsatch range, Utah Lake, and the Provo River. At Provo the two collectors separated, the former joining Lieutenant Hoxie's party on the way to Eastern Nevada, while the latter proceeded with your party through Spanish Fork Cañon to the valley of the Gunnison, and southward.

Lieutenant Hoxie's route was from Fairfield, Utah, making a detour westward to Fillmore, Utah, passing *en route* the Onaqui, Thomas, House, and Gosi-Ute ranges of mountains, and following quite closely the outward course of Captain Simpson in 1858 and 1859, the southern limit of the so-called American Desert was crossed, the extreme western limit reached being Schell Creek Valley, Nevada. From this point, the direction was south by east to Snake Creek Valley, due east across Confusion Range, past White Valley, traversing the House Range by means of Dome Cañon, south, to the crossing of the Sevier, a short distance above Deseret City, and thence to Fillmore.

The country traversed by this party was, in most instances, here and there, for miles in extent, either wholly destitute of vegetation, or at times relieved of its frightful barrenness by patches of sage-brush or dreary alkaline flats; even the few streams and water courses met with were triflingly diminutive, while the vegetation on their banks bordered well on to sterility. From the uninviting and infertile character of the country, and the rapidity with which the party necessarily moved, results in the way of specimens were not remarkable, although those secured amply repaid the time spent in their collection, and seemed to fully mark many of the peculiarities of the fauna and flora of the districts traversed.

From Fillmore the march was southerly along the main range in extension south of the Wahsatch, crossing this at Frémont's Pass; thence to the eastern valley of the Sevier, which was followed south to Panquitch, at which point much interesting work was done near the town and lake of the same name. From Panquitch the route was south and west to the Rio Virgen, along which the course lay to Toquerville, a rendezvous camp.

The party to which Mr. Henshaw, assistant, was attached, after crossing the main range, passed southward through Strawberry, Thistle, Sam

Pitch, and Grass Valleys, through Frémont's Pass westward to the regular wagon road, thence south to Toquerville. At the last mentioned point, a minor party was organized for special operations, and consisted of two collectors and assistants. This section, under myself, proceeded south to Saint George, Utah, via Washington, Utah, thence westward and northward to Pine Valley, east to Harmony, and north to Beaver, and finally to Provo, where considerable time was spent, as at the commencement of the field work. By moving leisurely from point to point, and making detours from time to time to localities of special interest, many valuable specimens were secured, as well as much important information that it would hardly have been possible otherwise to have gained. From Provo, the party proceeded to Salt Lake City, and disbanded.

The reports of the operations of the season will show that while much was accomplished of value to our own knowledge of the animal and vegetable characteristics of the region specially visited, the extensive collections obtained will enable a distribution to foreign museums of duplicate specimens, many of them unique, and highly desired to fill gaps in the Old World representations of North American zoölogy.

Finding that the results of the previous season fully warranted the increased facilities then afforded this branch of the expedition, it was determined in 1873 to prosecute with renewed vigor observations incident to this interesting study, and the following were named to continue the work, viz: Dr. J. T. Rothrock, Dr. C. G. Newberry, Dr. O. Loew, and Mr. H. W. Henshaw. The party rendezvoused at Denver, Colo.; Dr. Rothrock being assigned to Lieutenant Marshall's party, Dr. Newberry to Lieutenant Russell's, and Dr. Loew to your own, Mr. Henshaw setting out in advance to make collections at special points.

The party under Lieutenant Marshall left Denver, and proceeded westward through Middle Park, visiting Georgetown, Fairplay, South Park, Roaring Fork, Cochetopa, Saguache, and Tierra Amarilla. The party to which Dr. Newberry and Dr. Loew were attached operated in Northern and Southern New Mexico and Arizona; Mr. Henshaw joining Lieutenant Russell's party at Fort Wingate in Western New Mexico, and proceeded through Western and Southern Arizona. The very extensive collection of these gen-

tlemen fully attests their zeal and industry in their respective departments. To Dr. Rothrock, and his assistant, Professor Wolf, is due the credit of a botanical collection hardly surpassed under similar circumstances in point of number and variety of specimens, and to Mr. Henshaw that of a unique, and unprecedented collection of 1,200 bird skins.

In 1874, the results of the zoölogical collectors were simply unexampled, as a collection was secured excelling in value and magnitude that of any similar expedition. A party, consisting of Dr. J. T. Rothrock, H. W. Henshaw, and James M. Rutter, took the field early in May, and proceeded to Santa Fé, N. Mex., from which point their labors commenced. The route of travel selected was through portions of Western New Mexico and Arizona; the farthest southern point reached being old Camp Crittenden, not far from the Mexican boundary line, returning through Eastern Arizona and New Mexico to their point of departure in the latter part of December. Being independent of the topographical parties, they were enabled to carefully study the fauna and flora of certain areas not previously investigated, and in addition acquired valuable meteorological data. Another party left Pueblo, Colo., in July, consisting of Prof. E. D. Cope, W. G. Shedd, and R. J. Ainsworth, in charge of myself, and was organized for the especial purpose of investigating beds of fossil vertebrates and invertebrates in New Mexico and Colorado. As a detailed account of the routes of travel of the different parties has already been given in your annual report for 1874, it is unnecessary to repeat it here. In addition, the main or supply party had the services of C. E. Aiken as collector, who was able to add very largely to the stock of material gathered; and Dr. O. Loew, with Lieutenant Price's party, likewise furnished an important share.

Besides the labors of the regular collectors, it is pleasing to note the co-operation of many of the members of the different parties, who offered every assistance in their power to swell the general aggregate of results, among whom were Lieutenants Marshall, Hoxie, Russell, Whipple, and Birnie; Dr. O. Loew; and Messrs. Keasbey, Klett, Thompson, Gilbert, Howell, and Brown. It is also mentioned with pleasure that, during the entire time covered by the field operations of the survey, all the officers at the different military posts visited, cheerfully rendered every assistance

desired, and to their courtesy and uniform kindness much of the success of the natural history operations is attributable.

In the special work of preparing the reports relative to its collections, the expedition is under obligations to a number of distinguished scientists for their kind and gratuitous services in the work of identification of the individual specimens. The following are among the large number of the gentlemen in question:

In the determination of—

Mammals, thanks are due to Prof. S. F. Baird, of the Smithsonian Institution; Prof. Harrison Allen, of the University of Pennsylvania; Dr. Elliott Coues, U. S. A., naturalist of the Northern Boundary Survey; Prof. J. A. Allen, of the Museum of Comparative Zoölogy, Cambridge.

Birds, Prof. S. F. Baird; Dr. Elliott Coues, U. S. A.; Mr. Robert Ridgway, of the Smithsonian; Prof. J. A. Allen; Mr. George N. Lawrence, of the Lyceum of Natural History of New York; Mr. C. Hart Merriam, of the Yale Scientific School; Dr. Thomas Brewer, of Boston; Mr. William Brewster, of Cambridge; Mr. Charles E. Aiken, of Colorado; and Capt. C. Bendire, U. S. A.

Reptiles, Prof. S. F. Baird; Prof. E. D. Cope, of the Academy of Natural Sciences of Philadelphia; and Mr. G. Brown Goode, of the Smithsonian.

Fishes, Prof. S. F. Baird; Mr. G. Brown Goode; Prof. E. D. Cope; Prof. Theo. Gill; Mr. J. H. Milner, of the United States Fish Commission; Mr. T. Bean, of the Smithsonian; and Mr. M. P. Madsen, of Utah.

INSECTS.

Coleoptera, Mr. Henry Ulke, of Washington, D. C.; Dr. George H. Horn, of the Academy of Natural Sciences of Philadelphia; Prof. John L. LeConte, of the Academy of Natural Sciences of Philadelphia.

Lepidoptera, Mr. W. H. Edwards, of Coalburgh, W. Va.; Mr. Theo. L. Mead, of Cornell University, New York; Mr. R. H. Stretch, of San Francisco, Cal.

Orthoptera, Prof. Cyrus Thomas, of Washington, D. C.; Mr. S. H. Scudder, of Cambridge, Mass.; Prof. Townend Glover, of the Agricultural

Department, Washington, D. C.; Mr. Charles H. Dodge, Agricultural Department, Washington, D. C.

Hymenoptera, Prof. E. T. Cresson, of the American Entomological Society; Dr. A. S. Packard, jr., of the Essex Institute, Salem, Mass.; and Mr. Edward Norton.

Diptera, Baron C. R. Osten-Sacken, of the Museum of Comparative Zoölogy, Cambridge, Mass.

Hemiptera, Dr. P. R. Uhler, of the Peabody Institute, Baltimore, Md.

Spiders, Dr. William Holden, of Columbus, Ohio.

Neuroptera, Dr. H. A. Hagen, of the Museum of Comparative Zoölogy, Cambridge, Mass.

Leeches, Worms, Crustacea, and Larvæ, Prof. A. E. Verrill, of Yale College, New Haven, Conn.; Prof. J. Leidy, of the University of Pennsylvania; Dr. H. A. Hagen.

Mollusca, Mr. George W. Tryon, jr., of the Academy of Natural Sciences of Philadelphia; Mr. W. G. Binney, of Burlington, N. J.; Dr. James Lewis, of Mohawk, N. Y.; and Mr. Temple Prime, of New York City.

I have the honor to be, very respectfully, your obedient servant,

H. C. YARROW,

Acting Assistant Surgeon United States Army.

First Lieut. GEORGE M. WHEELER,

Corps of Engineers United States Army, in charge.

CHAPTER I.

NOTES

UPON

GEOGRAPHICAL DISTRIBUTION AND VARIATION

WITH REGARD TO

THE ZOÖLOGY OF THE WESTERN UNITED STATES AS RELATES MORE PARTICULARLY TO MAMMALS AND BIRDS.

BY

DR. H. C. YARROW.

ERRATA.

Reptiles and Batrachians.

Page 619, 14th line from bottom, for "O. pyromelas," read "O. pyrrhomelas."

Fishes.

Page 673, 9th line from top, after the word "proper," read "with."
Page 677, for "Alticolus," read "Alticolum."
Page 678, for "Fecundus," read "Fecundum."

Diurnal Lepidoptera.

Page 762, 10th line from bottom, for "Phyciodes," read "Melitæa."
Page 763, 6th and 11th lines from top and 13th line from bottom, for "Phyciodes," read "Eresia."
Page 786, 17th line from top, for "Epargyreus," read "Eudamus."
Page 792, under "Anthocharis," for "A. Ausonoides," read "A. Ausonides."

Zygænidæ.

Page 798, *dele* "Cochlidiinæ."
Page 799, 16th and 17th lines from top, *dele* "Zygænidæ" and "Castniinæ."
Page 802, 11th line from top, insert "Zygænidæ" before "Melanchroia."

Coleoptera.

Page 816, for "Straphylinidæ," read "Staphylinidæ."
Page 820, for "Lamphyridæ," read "Lampyridæ."

Orthoptera.

Page 863, 5th line from top, for "my Tr. pacifica," read "Scudder's Œdipoda atrox."
Page 863, 16th line from top, for "Tremerotropus," read "Trimerotropus."
Page 870, under "Syrbula fusco-vittata," for "Plate XLIII, fig. 5," read "Plate XLV, fig. 7."
Page 871, for "Leucocerca," read "Leucocera."
Page 873, 10th line from top, for "Pedioscertetis," read "Pedioscertetes."
Page 886, under "Eremobia magna," for "Plate XLV, fig. 1," read "XLIII, fig. 5."
Page 888, under "Pezotettix unicolor, Plate XLV," for "fig. 5," read "4."
Page 888, under "Pezotettix oregonensis, Plate XLV," for "figs. 2 and 3," read "1 and 2."
Page 889, under "Pezotettix Marshallii, Plate XLV," for "fig. 4," read "3."
Page 894, under "Caloptenus Yarrowii, Plate XLV," for "fig. 6," read "5."
Page 900, 17th line from top, for "Oxycorophus," read "Oxycoryphus."
Page 900, 11th line from bottom, for "Trimerotropis," read "Trymerotropus."
Page 901, 11th line from top, for "S. Leucocerca," read "leucocera."
Page 901, 8th line from bottom, for "P. Marshalli," read "P. Marshallii."
Page 905, under "Steiroxys bilineata," Plate XLV, for "fig. 7," read "6."
Page 918, 10th line from top, for "G. colubrinus," read "O. colubrinus.

CHAPTER I.

NOTES UPON GEOGRAPHICAL DISTRIBUTION AND VARIATION WITH REGARD TO THE ZOÖLOGY OF THE WESTERN UNITED STATES, AS RELATES MORE PARTICULARLY TO MAMMALS AND BIRDS.

The subject of the geographical distribution and variation of our western zoölogy is one that has of late years attracted more than ordinary attention from our naturalists; and, as appropriate to the subject-matter of this volume, it is here proposed to give a brief *résumé* of their conclusions and generalizations, as far as they may be deemed applicable to the special natural history work of the geographical surveys west of the one hundredth meridian.

It would be hazardous in the extreme to base a series of conclusions or generalizations upon the limited work of this expedition for the last few years; but enough has been gathered in that period to fully confirm and corroborate the opinions of Professors Baird, Cope, and Allen, and Mr. Ridgway in this regard. Of these scientists, Prof. J. A. Allen has probably paid more attention to the subject under discussion of late than the others; and, from his published papers, short excerpta may be permitted more particularly as touching upon mammals and birds.*

This gentleman, in view of his more recent studies in this line, now considers that we may recognize, in a general way, at least, five more or less well marked areas, characterized by certain peculiarities of variation of coloration; and that there exists a correlation between these areas and the prevalent increase of color and the amount of aqueous precipitation. No doubt, other and lesser areas, also characterized by certain similar peculiarities, will be recognized when a fuller examination of more material is afforded to admit of a careful and prolonged study of the subject.

* See Proceedings of the Boston Society of Natural History, vol. xvi, February 4, 1874.

Professor Allen defines these areas as follows:

"The first region is that of the Atlantic slope, which will include not only the countries east of the Alleghanies, but a large part of the British Possessions, extending westward at least as far as Fort Simpson, and thence northward and westward to Alaska, including apparently all of that territory north of the Alaskan Mountains, with an annual rain-fall throughout the whole of this extended region of about 35 to 45 inches. Over this region (to which may be given the general term *Atlantic Region*), the colors may be regarded as of the average or normal type; those of other regions being either of a diminished or increased intensity.

"The second region will embrace the Mississippi Valley, or more properly the Mississippi Basin, and may hence be termed the *Mississippi Region.* Here the annual rain-fall reaches 45 to 55 inches, and over a small area east of the Lower Mississippi even exceeds 60 inches. The tendency here is so often to an increase of fulvous and rufous tints, that we may regard it as the distinctive chromatic peculiarity of the region; these tints reaching their maximum in the limited area of greatest *humidity*, but a general increase in intensity of color is also more or less characteristic of the region.

"A third region embraces the central portion of the Rocky Mountains, and, being developed most strongly within the present territory of Colorado, and being also mainly included within that territory, may be termed the *Colorado Region.* The tendency here again, as compared with the immediately adjoining districts, is to a general increase of intensity of color, with also a marked inclination to the development of rufous and fulvous tints; this region being also within the influence of a comparatively high temperature, at least in summer. The humidity is here less than in either of the other regions already defined, the annual aqueous precipitation amounting to only about 24 to 30 inches; but it is yet greatly in excess of that of the districts immediately surrounding it.

"The fourth region may be regarded as made up of the arid plains and deserts of the great central plateau of the continent; including not only the 'great plains,' usually so called, but the deserts and plains of Utah, Nevada, Western Colorado, New Mexico, Arizona, and southwestward to Lower California, and may hence be appropriately termed the *Campestrian Region.*

The annual rain-fall is generally below 15 inches, but ranges at different localities from 3 to 20 inches; this increase or decrease depending greatly upon the position of such localities in immediate or close proximity to hills or mountains. Here a general paleness of color is the distinctive feature" It is in this region that nearly all the natural history work of the survey has been performed.

"The fifth region begins in the Pacific coast, at about the fortieth parallel, embracing a comparatively narrow belt along the coast from Northern California to Sitka. Its peculiarities are most strongly developed west of the Cascade range, north of 45°; they also prevail eastward nearly or quite to the main chain of the Rocky Mountains. It may hence be termed the *Columbian Region.* With an average annual rain-fall of 55 to 65 inches, the prevalent tendency in color is to dusky and fuscous, rather than rufous tints. The district between the Cascade range and the main chain of the Rocky Mountains presents features that may almost entitle it to rank as a distinct region, as might also the region of maximum rain-fall in the Mississippi Region. The southern half of Florida is also, perhaps, entitled to recognition as a distinct region, being characterized by excessive humidity and a sub-tropical intensity of color. It may also be necessary to eventually recognize as distinct districts the almost rainless portion of the Campestrian Region.

"In respect to the correlation of intensity of color in animals with the degree of humidity, it would perhaps be more in accordance with cause and effect to express this law of correlation as a *decrease* of intensity of color with a decrease of humidity; the paleness evidently resulting from exposure and the blanching effect of intense sunlight, and a dry, often intensely heated, atmosphere." This theory is strongly corroborated by the fact that, in the human race, many instances are known of persons, having dark hair and beards, losing their depth of color under the same condition and circumstances as affect other mammals as well as birds, and transmitting the lighter colors to the hair of their progeny. Professor Allen continues: "With the decrease of aqueous precipitation, the forest-growth and the protection afforded by arborescent vegetation gradually also decreases as of course does also the protection afforded by clouds, the excessively humid regions being also

regions of extreme cloudiness, while the dry regions are comparatively cloudless districts.

"In addition to the tendency to change of color with locality, there is another phase of color-variation that requires in this connection a passing notice, namely, *melanism*. It is now well known that almost every species of mammal may be expected to present melanistic individuals; instances of its occurrence in the majority of the North American species being now well established. Indeed, the very fact of a melanistic phase of coloration may be looked upon as almost *a priori* evidence that the individuals presenting it belong to a melanistic race of some species whose normal color is some other tint than black, as Professor Baird long since remarked in respect to the American squirrels. It has been supposed that the tendency to melanism is more prevalent at the northward; but such does not appear to be necessarily the case. Among the *Sciuridae*, for instance, a group rather remarkable for a tendency to melanistic varieties, the black and dusky forms are as often southern as northern. In some species, melanistic individuals are as rare as are the cases of albinism, as in *Sciurus hudsonius*, the species of *Tamias*, and in many of the *Spermophiles*, while in others they are sometimes the common, if not the prevalent, form over a considerable area, as occurs in *Sciurus cinereus* and *Sciurus carolinensis*. Melanism is often of frequent occurrence in *Sciurus aberti* and in *Spermophilus grammurus*, which presents a melanistic form both in Texas and in Lower California. *Spermophilus parryi* has also a black race along the Youkon River, and frequent instances of melanism are well known in all the species of *Arctomys*.

"In numerous instances, these melanistic individuals and melanistic forms have been described as distinct species, while, in reality, they are so sporadic in their occurrence as to render them hardly worthy of recognition even as varieties.

"The gradual increase of our knowledge in respect to the character of these melanistic forms, and especially in regard to the extent and character of geographical variation, necessarily leads to the modification of our views in respect to the status of many forms that have formerly passed current as more or less well established species, and also to consequent changes in nomenclature."

Professor Allen has thus been largely quoted from for the reason that his views embody the identical opinions held and expressed by the naturalists of this expedition, and are peculiarly adapted to the circumstances of this survey; and, although the above remarks apply more particularly to mammals, a law of generalization may be deduced, which will apply to birds also, and probably we may eventually be able to include reptiles and insects.

As an addition to the views of Professor Allen, it may be mentioned that, so far as regards color-variation, our attention should be drawn to the singular mimicry of color as seen more particularly by the collectors of the expedition in the Campestrian Region, or in localities contiguous thereto. This, as has been mentioned in a different portion of this report, was extremely well marked in the cases of reptiles, and such observations were taken as to prove the case beyond the cavil of a doubt. In the *Phrynosomæ* was it particularly noticeable, as also in some of the more brilliantly-colored serpents; and there can be no doubt that a law may yet be formulated in this respect which will equally apply to all classes of animals.

With regard to the distribution of birds and their color-variation, the same general rule may be applied as to mammals, differing slightly, however, in some minor particulars, and perhaps further quotations from Professor Allen* may serve to elucidate the matter better than any description of my own. We must premise, however, by stating that, within the last few years, so much has our knowledge increased respecting these interesting members of the animal kingdom, "that the opinions formerly current respecting the rank of a certain class of forms heretofore generally regarded as specific have been radically modified. Intergradation has been frequently traced between widely different forms; a gradual coalescence in scores of instances having been positively established, and rendered extremely probable in a large number of others.

"In North America, a geographical variation exhibits two marked phases (as has already been stated), a differentiation with differences of latitude and elevation; and, secondly, differentiation with differences of longitude, which, for convenience, may be termed respectively latitudinal and longi-

* Proceedings of the Boston Society of Natural History, vol. xv, June, 1872.

tudinal variation.* In respect to both, differentiation occurs in different degrees in different groups, in accordance with their general tendency to variation, or, as it were, in proportion to their normal degree of plasticity. In regard to variation with latitude, the modifications are apparently more general than in what I have termed longitudinal variation: the differentiation affects not merely color but size and the details of structural parts, whereas color appears to be the main element affected by longitudinal variation. The fact of variation in size has been conceded as a general law by the majority of at least American ornithologists and mammalogists, since it was so fully established by Prof. S. F. Baird, in 1857 and 1858, in his admirable reports on the Mammals and Birds of North America, published in the series of the Government reports on the exploration and survey of the various Pacific Railroad routes.

Professor Baird then and subsequently called attention to the fact of the greater length of the tail in several specimens of birds at certain localities, and cites instances of the larger size of the bill at southern points, and the paler color of the plumage of the birds of the plains and the arid peninsula of Lower California. All his subsequent works have furnished numerous citations of similar variation with locality; but, instead of insisting upon any common tie connecting these phenomena as the result of general laws, they are viewed as evidences of specific differentiation. The differences are indeed so great between many of the forms now known to intergrade that it is not surprising that they were regarded as different species when known from only a few examples, apparently unconnected by any intermediate form. Subsequently, however, it has been found that they are not trenchantly separated, intermediate forms so linking them together that they can be only vaguely diagnosed. These connecting links, inhabiting—at least in the breeding season—localities intermediate in geographical position and in climatic conditions to those frequented by the more extreme forms, suggest an intimate genetic relationship and a differentiation mainly or wholly through climatic influence, or the diverse conditions of environment.

"Latitudinal variation presents the following phenomena, which are of

* See Bulletin of the Museum Comparative Zoölogy, vol. ii, April, 1871.

such general occurrence that even the exceptions, if such there really be, are exceedingly few:

"1st. *As regards size:* There is a general reduction in the size of the individual, from the north southward, amounting not unfrequently to as high as 10 to 15 per cent. of the maximum size of the species. The reduction is much greater in some species, and in some groups of species, than in others, but is almost invariably considerable and easily recognizable.

"2d. *In respect to the bill:* The variation of the bill is somewhat inverse to that of the general size; as a rule the southern forms having generally relatively, and often absolutely, larger bills than northern ones, the increased size taking different proportions in different species and different styles of bill. Those of a stout, thick, conical form generally increase in size, but especially in thickness. Those of a slender alternate form become slenderer and relatively longer at the southward, with a decidedly greater tendency to curvature.

"3d. *In respect to the claws:* A similar increase in size is apparent in the claws, especially in that of the hallux, at southern localities, perhaps less marked and less general than the increase of the bill, with which it evidently correlates.

"4th. *In respect to the tail:* A marked elongation of the tail at the southward has been noticed in many cases, both in Cape St. Lucas birds (Baird) and in those of Florida.

"5th. *In respect to color:* The differences in color are especially obvious, and may be reduced to two phases of modification: (*a*) a general increase in intensity at the southward; and (*b*) an increase in the extent of dusky or black markings at the expense of the intervening lighter or white ones, or, conversely, the reduction in size of white spots and bars. Under the general increase in intensity, the iridescence of lustrous species becomes greater, and fuscous, plumbous, rufous, yellow, and olivaceous tints are heightened in species with the color continuous in masses.

Under the repression of light colors, the white or yellowish edgings and spots on the wings and tail become more or less reduced; and frequently, to a great degree in species barred transversely with light and dark colors, the dark bars widen at the southward at the expense of the white or lighter

ones, sometimes to such an extent as to greatly change the general aspect of the species, as is the case in the *Ortyx virginianus* of the Atlantic States, and in other well known species; also, under the tendency to the increase of dark colors, longitudinal streaks and blotches in a light ground increase in extent and intensity of color.

"In respect to longitudinal variation, the differences appear to be mainly those of color, and to hold a direct relationship to the humidity of the climate. On the arid plains of the middle and western portion of the continent, the annual rain-fall is less than half that of the eastern half of the continent, while a rain-belt occurs on the Pacific coast stretching northward from near the mouth of the Columbia River to Alaska, over which the annual rain-fall is double that of any portion of the eastern half of the continent. Taking the species that present a nearly continental range, we find that almost invariably they pass gradually into the pallid forms of the interior at the eastern edge of the arid plains; the greatest pallor being developed in the driest regions, as the peninsula of Lower California, and the almost rainless belt along the Colorado River, and northward along the eastern base of the Sierra Nevada Mountains; that on the Pacific slope they again re-assume nearly the tints of the eastern form; but more to the northward, over the above mentioned rainy region, they acquire a depth of color far in excess of what the species presents in the Atlantic Region. This coincidence of bright and pale tints with the relative humidity of the locality is certainly suggestive, if not demonstrative, of the relation of cause and effect between these two phenomena, since the same rule is traceable over large portions at least of the Old World; the Scandinavian forms, for instance, being darker-colored than the conspecific races of Central Europe, and these again darker than those of Northern Africa and the adjacent regions. Humidity alone, or in conjunction with greater intensity of light, seems equally well to account for the increase of color to the southward. Yet from the well known bleaching effect of sunlight, intensified by reflection, upon the colors of animals living upon sandy islands and sea-beaches and desert interior regions, it seems doubtful whether the larger share of modification in intensity of color in birds may not be due to humidity alone, or to humidity and a high temperature together, rather than to intensity of light.

In regard to the enlargement of peripheral parts, to the southward, it seems not unreasonable to suppose that the increase of temperature in stimulating the circulation in these exposed members may have something to do with it, especially in view of the evidence afforded by mammals, which, in general, present climatic modifications parallel with those of birds.

"Whatever may be the cause of the above modifications of structure and color, at different localities, we certainly find the following coincidences:

"1st. In accordance with the increase in the intensity of color in individuals of the same species from the north southward, in the northern hemisphere, the brighter colored species in general represented in both the temperate and tropical regions occur, as a general rule, at the southward; the same fact holding good also for sub-families. In cosmopolitan genera, families, etc., the tropical species are almost always brighter colored than the extra-tropical ones. All the most gorgeously colored families of birds are either exclusively tropical or semi-tropical, with generally the outlying species more plainly colored than the average for the family.

"2d. In accordance with the increase in the size of the bill at the southward, all the species that have this member enormously developed are tropical or semi-tropical; not only such families as have the beak at its maximum of development, as the toucans and hornbills, but in all groups in which it is unusually large, the extreme development is reached in the inter-tropical regions.

"3d. In respect to the tail, with very few exceptions, all long-tailed forms reach their highest development within or near the equatorial regions.

"The facts indicated above in respect to the inosculation of forms formerly regarded as specifically differentiated will evidently require modifications of the hitherto accepted nomenclature. Evidently, many of these forms are so strongly marked that they should be, in some manner, recognized in nomenclature, though admittedly of less than specific rank. Most naturalists now practically recognize as species such groups of individuals as are not known to graduate by nearly imperceptible stages into any other similar group, and as varieties such groups of individuals as occur at certain localities, or over certain areas, which differ more or less from other groups inhabiting other (generally contiguous) localities, with which there is evi-

dence that they do more or less fully intergrade. Convenience seems to demand such a course, in order to enable the naturalist to specify what particular variety or race of a species inhabits a given section of country: a method, in fact, already more or less generally practiced."

With the question of the bearing of these facts of geographical distribution and variation upon the matter of the origin of genera and species, we have at present nothing to do; but that they form an important element in the solution of the problem is none the less certain.

With regard to the causes which influence the migration of birds, the celebrated Swedish poet Runeberg, during a long and severe illness at Helsingfors, occupied himself in observing their habits, especially in regard to migration, and ascribes it to an ardent and intense longing for light. This ingenious theory, which is hardly to be considered tenable, he explains as follows:

"When the days shorten in the north, the birds go south; but as soon as the long northern nights set in with their luminous long-drawn hours, the wanderers return to their old haunts. It is generally supposed that they move southward to get more abundant food. But why do they leave the rich southern feeding grounds to return northward? Simply because one thing is richer there, and that is light. The same instinct that makes plants turn toward the light, and stretch their branches to reach it, also works in birds, and compels them to fly after and follow it. The bird of passage is of noble birth; he bears a motto, and his motto is *Lux mea dux.*"

But Prof. Alfred Newton, in discussing this theory in "Nature and Science" for January, says:

"In some cases, scarcity of food would seem to be a sufficient cause; and it is undoubtedly the most obvious one that presents itself to our mind. As food grows scarce toward the end of summer in the most northern limits of the range of a species, the individuals affected thereby seek it in other countries. Thus doing, they press upon the haunt of other individuals; these in like manner upon that of yet others; and so on, until the movement, which began in the far north, is communicated to the individuals occupying the extreme southern range of the species at that season; though, but for such an invasion, these last might be content to

stay some time longer in the enjoyment of their existing quarters. When we consider, however, the return movement, at the end of winter, it is doubtful, I think, whether scarcity of food can be assigned as its sole or sufficient cause. But here we feel the want of knowledge. At present, we are far too little acquainted with the physical peculiarities of those more equatorial regions, which in winter are crowded with emigrants from the north, to come to any final decision. It seems not too violent an assumption to suppose that, though such regions are well fitted for the winter resort of the bird population of the north, they may be deficient in certain necessaries for the nursery; and it seems still less of an assumption to suppose that even if such necessaries are not wanting, yet that the regions in question would not supply food sufficient for both parents and offspring. But another point must not be overlooked. The most sedentary of birds year after year occupy the same quarters in the breeding season. It seems to me, therefore, that among the causes of migration the desire of returning to old haunts must be included."

With regard to the distribution of reptiles and fishes, and their color-variation, from our present standpoint of knowledge, we cannot as yet apply the same generalization that governs the other classes; but we do know that the brightest colored individuals, and the largest generally of these two classes, are found in tropical or semi-tropical regions.

Unfortunately, reptiles particularly are rather restricted in their ranges, and cannot move from point to point with the regularity and rapidity of birds, so that what we might apply to the class in general will not apply to species, with but one exception as far as known, and for the reason that we find distinct species inhabiting distinct localities, northern forms being replaced by southern ones, with no intergradation of colors or varieties. The one exception in the case of serpents is that of *Ophibolus triangulatum*, which, as it proceeds southward, becomes darker and larger.

With regard to the geographical distribution of insects, and their color-variation thereupon depending, as yet the subject has not received the share of attention that has been accorded to other classes, consequently we are not in position to give any generalization regarding them; but we may say as we have said of reptiles, that the largest and brightest colored species

are generally found to the southward, this statement applying more particularly to the *Coleoptera* and *Lepidoptera*. It is only within the last few years that anything has been known of the insect fauna of the Rocky Mountain range proper and the area west of it; and, as our knowledge increases, we will possibly be better able to establish a theory or theories of development, distribution, and color-variation, which will aid in establishing a general law, applying to all classes of animated nature.

Thanks are due to Professor Allen for his kindness in permitting the use of his papers already mentioned, and for his criticism of this chapter.

CHAPTER VI.

REPORT

UPON

THE COLLECTIONS OF FISHES

MADE IN PORTIONS OF

NEVADA, UTAH, CALIFORNIA, COLORADO, NEW MEXICO, AND ARIZONA,

DURING

THE YEARS 1871, 1872, 1873, AND 1874.

BY

PROF. E. D. COPE AND DR. H. C. YARROW.

CHAPTER VI.

This report is based upon the entire collection of fishes made in Nevada, Colorado, Utah, New Mexico, Arizona, and California, during the years 1871, 1872, 1873, and 1874, by the different nauralists attached to the expedition.

Of the collection of 1871, made by Mr. F. Bischoff, but few specimens remain to attest the painstaking industry of this well known collector, most of them having been destroyed by fire before reaching this office. Fortunately, with the exception of one can of specimens destroyed by leakage of alcohol, the collection of 1872 reached Washington in good condition, as did that of 1873; and it will be found that, from this material, most valuable information has been acquired relative to the western forms of ichthyic life.

As one of the most valuable results derived from a study of the collection, it appears that the basin of the Colorado River is the habitat of a small group of fishes of the family *Cyprinidæ*, which may be called the *Plagopterinæ*, which embraces three genera—*Plagopterus*, Cope; *Lepidomeda*, Cope; and *Meda*, Girard. The group differs from others of the family in the possession of two strong osseous rays of the dorsal fin, the posterior of which is let into a groove in the hinder face of the anterior without being coössified with it, thus constituting a compound defensive spine. The rays of the ventral fin, excepting the first and second, are similarly modified. The greater part of their length consists of an osseous dagger-shaped spine, with grooved posterior edge, which overlaps the border of the succeeding ray, when the fin, like a fan, is closed up. The articulated portion of the ray either emerges from the groove below the free acute apex of the spine, or appears as a continuation of the apex itself. It is worth observing that the only other instance of this ossification of the ventral rays is to be seen in

the extinct family of the *Saurodontidæ* of the Cretaceous period; the nearest approach among recent fishes being the internal spine in the ventral fin of *Amphacanthus*. The dentition and intestines of these fishes show them to be of carnivorous habits. Interest attaches to the *Plagopterinæ* as the only type of fishes not known from other waters than those of the Colorado and San Luis basins.

Another result is the discovery in the West of *Ceratichthys biguttatus*, Kirtland; Dr. H. C. Yarrow obtaining a number of specimens of this abundant eastern fish at Harmony, in Southern Utah. This is an unexpected discovery, giving the species the greatest known range of any of our *Cyprinidæ*, the *Semotilus corporalis* accompanying it to the eastern slope of the Rocky Mountains. The Smoky Hill River was previously the most western locality for the *C. biguttatus*.

Coregonus villiamsonii, Girard, was found singularly abundant in the Provo River, a stream running into Utah Lake; it being known to the settlers under the name of "Mountain Herring". During the fall of the year, it bites readily at a hook bated with "Leatherside Minnows," (*Gila tænia*, Cope,) and thousands are annually captured and sent to the Salt Lake City market, being there justly esteemed as a most valuable food fish.

This species was established by Girard upon specimens taken in Des Chutes River, Oregon. In 1871, Mr. Campbell Carrington, of the United States geological survey of the Territories, found it, but the locality is not noted; and in 1872 it was found in the Provo River, as already noted. This is the first and only time it has been observed in the valley of the Great Salt Lake. *Salmo virginalis*, Girard, the characteristic and most valuable food fish of Utah, was found exceedingly abundant in the fresh-water lakes, notably Utah and Panquitch Lakes, and furnishes a large proportion of the subsistence of the Mormon settlers.

Another interesting discovery was that of a new species of Cottoid, named *Uranidea vheeleri*, Cope, which is the only Physoclystous or spinous-rayed fish as yet found in the Great Basin of Utah.

It will be seen by an examination of this report that the material secured has enabled us to establish three new genera and nineteen new species of fishes, besides several varieties from the Western Territories, and no rea-

sonable doubt exists but that this list may be largely increased by future explorations.

It is proper to add that in the preparation of this report Prof. E. D. Cope has examined and described the new genera, and nearly all the species, and Dr. H. C. Yarrow has made certain needful comparisons, and prepared the synonymy and bibliography, besides furnishing the lists, with notes upon the different specimens enumerated.

CHONDROSTEI.

SCAPHIRHYNCHOPS PLATYRHYNCHUS, Raf.

Acipenser platorynchus, RAFIN., Ichthy. Ohiens, 1820, 80.—KIRTLAND, Rep. Zoöl. Ohio, 1838, 196.—*Id.*, Bost. Jour. Nat. Hist., v, 1845, 25, pl. viii, f. 1.—STORER, Synopsis, 1846, 249.

Scaphirhynchus rafinesquii, HECK, Ann. Wien. Mus. Naturg., i, 1835.—*Id.*, Zoöl. Abhandl. Ann. Wien. Mus. Naturg., i, 1841, 72, pl. viii.

Scaphirhynchus platirhynchus, BD., Iconogr. Encycl., ii, 1850, 238.—GIRARD, P. R. R. Rep., x, 1859, Ichthy., 357.

Two specimens (L 51), obtained from the Rio Grande, near Albuquerque, by Dr. Oscar Loew, differ in minor and only individual characteristics from typical specimens from the Ohio River. The range of this sturgeon is thus extended farther west than has heretofore been observed. It is not included in the enumeration of fishes of the Rio Grande in Girard's Ichthyology of the United States and Mexican Boundary.

PHYSOSTOMI.

GINGLYMODI.

Descriptions received from various intelligent persons indicate that a species of gar occurs in the Rio Grande; but no specimens were obtained by the expedition.

ENCHELYCEPHALI.

ANGUILLA TYRANNUS, Gir.

Anguilla tyrannus, GIR., U. S. & Mex. Bound. Surv., ii, Ichthyology, 75.

Three specimens from near Santa Fé (Dr. H. C. Yarrow).

NEMATOGNATHI.

AMIURUS NEBULOSUS, Les.

Amiurus nebulosus, LESUEUR, COPE, Proc. Am. Phil. Soc. Phila., 1870, 485–486.

A specimen resembling those described by Professor Gill, from Minnesota, as *A. obesus*, which we regard as a variety of the common eastern "catfish".

Radii: D. I. 6; A. 17; V. 8.

Arkansas River, Pueblo, Colo. (Mr. C. E. Aiken).

PLECTOSPONDYLI.

PLAGOPTERUS, Cope.

Pharyngeal teeth, 2.5–4.2; raptorial uncinate, without masticatory surface. A terminal maxillary barbel. Scales, none; lateral line well developed. Dorsal fin with a strong spine composed of two, the posterior received into a longitudinal groove of the anterior. Ventral fins originating (in the type species) a little anterior to the line of the dorsal, attached to the abdomen by a wide basis and length of inner radius. Superior labial fold continued round the end of the muzzle.

This genus resembles *Meda*, Girard, in the presence of the dorsal spine, the adhesion of the inner border of the ventral fin, and the absence of scales, and differs in the presence of barbels, and the inner dental series being 5–4, instead of 4–4. Physiognomy of *Rhinichthys*.

PLAGOPTERUS ARGENTISSIMUS, Cope.

PLATE XXVI, FIGS. 3, 3*a*.

Plagopterus argentissimus, COPE, Proc. Am. Phil. Soc. Phila., 1874, 130.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 4.

This is a small fish, of slender proportions, with a rather broad head, with slightly depressed muzzle overhanging by a little a horizontal mouth of moderate size. The caudal peduncle is of medium depth, and the caudal fin is deeply forked. The eye is somewhat oval, and enters the length of the side of the head 4.2 times and the interorbital width 1.5 times. The greatest depth (near the ventral fin) enters the total length nearly six times,

or five and three-fourths exclusive of the caudal fin. The latter measurement is four times the length of the head. The origin of the dorsal is entirely behind the proper basis of the ventral; its first spine is curved and longer than the second, and its basis is intermediate between the base of the caudal and the end of the muzzle. The dorsal rays behind the spine have the basal two-thirds to one-half thickened and completely ossified; the articulated portions issuing from the apices of the spines. Radial formula: D. II. 7; C. 19; A. I. 10–9; V. 2. V; P. 16. The first or osseous ray of the anal is rudimental; the fifth spinous ray of the ventral is bound by nearly its entire length to the abdomen by a membrane. The pectoral rays from the second to the sixth exhibit a basal osseous spinous portion, which is not nearly so marked as in the ventrals. The pectorals reach the basis of the latter.

The lateral line is complete, and is slightly deflexed opposite the dorsal fin. The lips are thin, and the end of the maxillary bone extends to the line of the front of the orbit. Total length, $0^{m}.071$; length to middle of basis of caudal fin, $0^{m}.0565$; to anterior basis of anal fin, $0^{m}.040$; to basis ventral, $0^{m}.021$; of head, $0^{m}.0145$; of muzzle, $0^{m}.004$; width at posterior nares, $0^{m}.006$; at middle of pterotic, $0^{m}.0078$. Color, pure silver for a considerable width above the lateral line. Dorsal region somewhat dusky from minute chromatophoræ.

The plate affords a view of this species in profile and of the ventral aspect.

Numerous specimens from the San Luis Valley, Western Colorado.

MEDA, Gir.

Meda, GIR., Proc. Acad. Nat. Sci. Phila., 1856, 192.—*Id.*, U. S. & Mex. Bound. Surv., Ichthyology, 50.

This genus resembles *Plagopterus* in the absence of scales, while it differs in the absence of barbels and the reduction of the number of teeth of the larger pharyngeal series to 4–4. Girard also asserts twice that the dorsal spine is "articulated", a character not observed by us in any species of the group. His figure of *M. fulgida* represents the ventral radii as articulated; but as there are other points in which it differs from the description, it is probably inaccurate.

MEDA FULGIDA, Gir.

Meda fulgida, GIR., Proc. Acad. Nat. Sci. Phila., 1856, 192.—*Id.*, U. S. & Mex. Bound. Surv., Ichthyology, 50.—COPE, Proc. Am. Phil. Soc. Phila., 1874, 131.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 5.

A small species from the Rio San Pedro, a tributary of the Gila, in Southern Arizona.

LEPIDOMEDA, Cope.

Lepidomeda, COPE, Proc. Am. Phil. Soc. Phila., 1874, 131.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 5.

Dorsal fin originating behind the line of the ventrals, which adhere to the belly by the inner ray; body scaled, lateral line present; pharyngeal teeth 4–4 in the inner row; no barbels; premaxillary series complete.

This genus has the physiognomy of *Clinostomus*. The presence of scales distinguishes it from *Meda*. The spinous rays are not articulated.

LEPIDOMEDA VITTATA, Cope.

PLATE XXVI, FIGS. 2, 2*a*.

Lepidomeda vittata, COPE, Proc. Am. Phil. Soc. Phila., 1874, 131.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 5.

Form moderately stout; the greatest depth (at the first dorsal ray) entering the length to the basis of the caudal fin four and a quarter to a third times. The head is wide and flat above, with decurved pterotics, and slightly depressed behind the interorbital region; muzzle obtusely descending, not prominent; mouth terminal and descending to a point below the anterior line of the pupil. Length of head 3.75 times in total length to basis of caudal fin; orbit round, 3.75 times in length of head, and 1.3 times in interorbital width. The latter is not uniform, but the middle plane is elevated a little above the superciliary ridges, and separated from them by a shallow groove. Nares sublateral. Teeth 2.4–4.2. Preorbital trapezoid.

Scales small, covering the whole body, except a space behind the pectoral fin, in twenty-six series above the lateral line, and fifty-six transverse in front of the dorsal fin. Radial formula: D. II. 7; C. 19; A. I. 8; V. 1. VI; P. 15. There are several peculiarities in the constitution of the spines of the fins in which the species differs from *Plagopterus argentissimus*. Thus

the second dorsal spine is wider than the first, and so deeply grooved behind as to represent a V in section; it also extends to the extremity of the first, while it is shorter in *P. argentissimus*. The remaining dorsal spines are less distinctly enlarged and ossified; those of the ventrals are less developed, and their apices, instead of being free, continue into the terminal articulated portion. The pectoral radii are scarcely enlarged at all. The base of D. I. is nearer the basis of the caudal fin than the end of the muzzle by the length of the latter to the posterior nares. Caudal fin deeply forked. Total length, 0^{m}.085; length to the basis of the caudal fin, 0^{m}.0685; to the basis of the anal, 0^{m}.047; to the basis of the ventral, 0^{m}.0325; length of the head, 0^{m}.018; length to the orbit, 0^{m}.043; width at the posterior nares, 0^{m}.006; at the middle of the pterotic, 0^{m}.009. Color silver to half way between lateral and dorsal lines; the upper part of it underlaid by a lead-colored band; a median dorsal black band from front to caudal fin.

The plate affords a view of this species in profile and of the ventral aspect.

Numerous specimens from the Colorado Chiquito River, Arizona, collected by H. W. Henshaw, No. 5, X. P. The largest species of the group.

LEPIDOMEDA JARROVII, Cope.

PLATE XXVI, FIGS. 1, 1*a*.

Lepidomeda jarrovii, COPE, Proc. Am. Phil. Soc. Phila., 1874, 133.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 6.

A species resembling the last in many respects, but differs in a greater elongation of form, weakness of squamation, and peculiarity of coloration. The fin radii are similar in number and character, but the dorsal is furnished with more slender spines. The chin projects a little beyond the upper lip when the mouth is closed. The depth of the body at the ventral fins enters the length of the basis of the caudal 5 to 5.25 times, and the head enters the same four times. The eye is larger than in *L. vittata*, entering the length of the head 3.25 times and equaling the interorbital width. The end of the maxillary bone reaches the line of the anterior border of the orbit. The pectoral fin reaches the ventral, but the latter does not attain the vent. The scales are difficult to detect; there are 51 transverse series between the head and the dorsal fin. Total length, 0^{m}.081; length

to the caudal fin, 0m.065; to the anal, 0m.0465; to the ventral, 0m.032; length of the head, 0m.0165; length to the orbit, 0m.0048; width between the orbits, 0m.005; between the middle of the pterotics, 0m.008.

Color olivaceous above, with a median black vertebral band; sides to above lateral line silvery, leaden edged above; bases of ventral fins red.

Dedicated by Professor Cope to Dr. Henry C. Yarrow, zoölogist of the surveys west of the 100th meridian.

No.	Locality.	Date.	Collector.
505	Colorado Chiquito River, Ariz	July, 1873	H. W. Henshaw.
5 X	do	do	Do.

RHINICHTHYS, Agass.

RHINICHTHYS MAXILLOSUS, Cope.

PLATE XXVII, FIGS. 1, 1*a*.

Rhinichthys maxillosus, COPE, Proc. Acad. Nat. Sci. Phila., 1864. 278.

This is the common *Rhinichthys* of New Mexico, and was collected in considerable numbers. Scales, $\frac{13}{13}$; anal radii, I. 7; dorsals always I. 8, or one less than in the typical *Apocope henshavii* of Utah Lake. The largest specimen is from the Rio Chama at Abiquiu, and measures five inches in length. Numerous specimens from the Upper Rio Grande and the Rio Chama. Radii: D. I. 8; A. I. 7. Scales: (No. 1) $\frac{13}{13}$ 70; (No. 2) $\frac{13}{14}$ 72.

No.	Locality.	Date.	Collector.
247 E	Tierra Amarilla, N. Mex	Sept., 1872	Dr. H. C. Yarrow.
120	Twin Lakes, Colo	July, 1873	Dr. J. T. Rothrock.
52 E	Colorado Springs, Colo	July, 1874	John Yarrow.
L 6	Abiquiu, N. Mex	Aug., 1874	Dr. O. Loew.
227 A	Nutria, N. Mex	do	W. G. Shedd.
126	Costilla Creek, N. Mex	do	Prof. E. D. Cope.
113	Taos, N. Mex	do	Dr. H. C. Yarrow.
239	San Ildefonso, N. Mex	do	Do.

APOCOPE, Cope.

Apocope, COPE, U. S. Geol. Surv. Terrs., 1871, 472.

A fish referred below to the *Apocope vulnerata*, Cope, five inches in length, presents a completed lateral line, and is thus different from the types of

Apocope; but the specimens originally described under this name from Logan, Utah, are not fully grown. I suspect that in adults of this genus the lateral line will be found to be developed. The genus will then require to be further defined in expression of its distinctive features as compared with *Ceratichthys.* The character to be added is the position of the dorsal fin, which is behind the line of the ventrals, as in *Rhinichthys,* while in *Ceratichthys* the dorsal is on or before the line of the ventrals. The known species of *Apocope,* Cope, are these: *A. carringtonii,* Cope; *A. henshavii,* Cope; *A. vulnerata,* Cope; *A. couesii,* Yarrow; *A. ventricosa,* Cope; and *A. oscula,* Girard.

The species of this genus are all of small size, and difficult of determination. For the purpose of aiding the student, the following synoptic table is given:

A. The lateral line very short.....*Apocope.*

Scales larger, $\frac{10}{11}$ 60; muzzle short; D. I. 8 .....*A. carringtonii.*

AA. The lateral line complete or imperfect on a part of the caudal peduncle, *Eritrema.*

Scales medium, $\frac{16}{12}$ 67; D. I. 9.....*A. henshavii.*

Scales $\frac{15}{12}$ 70; lateral line imperfect; muzzle short; D. I. 8, *A. vulnerata.*

Scales $\frac{10}{10}$ 63; lateral line sometimes imperfect; muzzle long; D. I. 8, *A. oscula.*

Scales small, $\frac{13}{10}$ 80; muzzle long; D. I. 8 .....*A. couesii.*

Scales very small, $\frac{16}{14}$ 89–95; muzzle not elongate; D. I. 8, *A. ventricosa.*

APOCOPE CARRINGTONII, Cope.

Apocope carringtonii, COPE in Rep. U. S. Geol. Surv. Montana, &c., 1871, 472.

Warm Springs, Utah.

APOCOPE HENSHAVII, Cope.

PLATE XXVIII, FIGS. 2, 2*a*.

Rhinichthys henshavii, COPE, Proc. Am. Phil. Soc. Phila., 1874, 133.—*Id.*, Plagop. & Ichthy. Utah, 1874, 7.

An elongate species, with small scales and overhanging but obtuse muzzle, resembling a *Ceratichthys* of the group of *C. nubilus* (*Rhinichthys*),

APOCOPE COUESII, Yarrow, *sp. nov.*

PLATE XXVII, FIGS. 2, 2*a*.

Rhinichthys henshavii, var. III, COPE, Proc. Am. Phil. Soc. Phila., 1874, April, 133.

This species might almost be considered a variety of *Apocope henshavii*, Cope; but on considering the differences between the specimens examined and those of the last named species, I believe it to be entitled to be retained as a separate species. Form elongate, but broader than *A. henshavii*, with overhanging, obtuse, but broader muzzle, scales larger Depth enters the total length, including caudal fin, 5.75 to 6.25 times, the head entering the same 4.50 to 5 times. Eye 6 times in length of head; 1.75 in interorbital width. Base of Dorsal I. is nearer insertion of caudal than end of snout. Ventral fins nearly reach the anal, and are nearly reached by the pectorals. Dorsal fin originating behind the base of the ventrals. D. I. 8; A. I. 7; V. 7; P. 12. Scales, $\frac{14}{67.}{}_{12}$ Color whitish-yellow, with numerous large bluish-black spots on back and sides, increasing in intensity toward occiput; no dark stripe on sides. Inferior fins yellowish.

This species is named in honor of Dr. Elliott Coues, U. S. A., the distinguished naturalist of the Northern Boundary Commission, to whom this expedition is indebted for many favors.

Was found very abundant in mountain streams of Arizona.

No.	Locality.	Date.	Collector.
754	Near Camp Apache, Ariz	Oct. 11, 1873	H. W. Henshaw.

APOCOPE VENTRICOSA, Cope.

PLATE XXVIII, FIGS. 1, 1*a*.

Ceratichthys ventricosus, COPE, Proc. Am. Phil. Soc. Phila., 1874, April, 136.—*Id.*, Rep. Plagop. & Ichthy., Utah, 1874, 10.

This species resembles a *Rhinichthys* in its small scales and rather elongate form and in coloration. The muzzle does not overhang the mouth, but the lower jaw is received within the upper. The head is not wide, and is narrowed anteriorly, but the muzzle is obtuse both on the vertical and lateral view. Orbit four times in length of head, and 1.33 times in interorbital width

and length of muzzle. Length of head four, and depth of body four and three-quarters times in length without caudal fin. Radii: D. I. 8; A. I. 7; the first dorsal ray intermediate between the base of the caudal fin and the posterior border of the orbit, and a little behind the line of the basis of the ventral fins. Pectorals reaching three-fifths the distance to the ventrals; the latter not quite reaching the anal. Caudal peduncle stout. The barbels are small, and in some specimens appear to be wanting on one side or both. Scales very small, $\frac{18}{89}$. Isthmus wide. Color dusky olive above, white below. A dark band along the side of the head through the orbit. A similar black band occupies the middle of the sides on the posterior two-thirds of the length, which is well defined above and below, and is sometimes irregularly shaded.

Length of a specimen to base of caudal, 0m.061; length to base of anal, 0m.043; to base of ventral, 0m.033; to base of dorsal, 0m.035; length of head, 0m.0162; width of head between orbits, 0m.0045; at middle of pterotics, 0m.0073.

A red spot in the axils of the ventral and pectoral fins, one at the superior canthus of the branchial fissure, and one on the side of the muzzle. Length three inches.

Specimens from Arizona and New Mexico.

ALBURNELLUS, Gir.

This genus was established by Girard in Proc. Acad. Nat. Sci. Phila., 1856, 193, and represents and nearly resembles the *Alburnus* of the Old World. The dental formula is 2.4–4.2; the teeth without masticatory surfaces. The dorsal fin rises behind a point opposite to the basis of the ventrals.

ALBURNELLUS SIMUS, Cope, *sp. nov.*

PLATE XXXI, FIGS. 2, 2*a*.

Represented by many individuals from the Rio Grande. It is of rather stout form for the genus, and resembles especially the typical forms of *Hybopsis* in its decurved, obtuse muzzle. It is, however, a true *Alburnellus* as indicated by the dentition and position of the ventral fins. The first dorsal ray stands above the last ray of the ventrals, and the latter fins, appressed, reach the line of the last ray of the dorsal. The teeth are 4.1–1.4 of the

raptorial type, and without grinding surface; but it is rare to find all the teeth of the longer row in functional use at one time. In fact, in several specimens examined, I found the upper tooth wanting; in one, the lower tooth was not anchylosed.

Dorsal outline but little arched; caudal peduncle a little contracted, Head short and wide; the muzzle abruptly descending to the terminal mouth. Mouth descending a little posteriorly; the end of the maxillary extending a little beyond the anterior margin of the orbit. Eye rather small for the genus, 4.2 times in length of head, 1.2 in length of muzzle, and twice in interorbital width. Head 4.2 times in the length to the basis of the caudal fin, or 5.4 times including the large caudal fin. Depth of body equal the length of the head; width of latter behind equal 0.6 of its length. Scales, $\frac{8}{35}$; 22 cross-rows in front of dorsal fin. Radii: D. I. 8; A. I. 9, sometimes I. 10; V. 8, not reaching vent; pectorals extending 0.6 the distance to the ventrals. Total length, 0^{m}.084; length to basis of caudal fin, 0^{m}.067; to basis of first ray of dorsal, 0^{m}.038. In life, entirely silvery, with a broad band on the side, of a more brilliant hue of the same.

No.	Locality.	Date.	Collector.
158 A	San Ildefonso, N. Mex	Aug., 1874	Dr. H. C. Yarrow and Prof. E. D. Cope.

ALBURNELLUS JEMEZANUS, Cope, *sp. nov.*

PLATE XXXI, FIGS. 3, 3*a*.

A species of the usual typical form of the genus, viz, with slender body, and mouth descending obliquely backward. Scales large, $\frac{5}{34\text{-}5}$; 19 rows between dorsal fin and occiput. First dorsal ray opposite base of last ventral ray; ventral fin appressed, reaching a little beyond last dorsal, but not to vent; pectoral extending three-fourths the distance to the ventral. Radii: D. I. 8; A. I. 10; V. 8; caudal long and deeply forked. Muzzle acuminate; in profile gently descending from the nares to the lip. Maxilla extending beyond line of orbit. Symphysis mandibuli acuminate. Orbit 3.6 times in length of head, once in muzzle, and 1.25 times in interorbital

width. Width of head behind one-half the length. Length of head entering 4.2 times total to base of caudal; greatest depth of body nearly six times in the same. Total length, 0m.082; length to basis of caudal fin, 0m.60; to basis of dorsal fin, 0m.033.

Color silvery, with a broad, silvery, lateral band, which has a leaden superior margin; a dusky dorsal band.

The dentition of this species, like that of the *Gila ?egregia*, is frequently anomalous; normally 4.1–1.4, it is sometimes on one side 4.3.2–, 1.4.1–, and 2.2.2. It seems to be nearly allied to the eastern *A. jaculus*.

No.	Locality.	Date.	Collector.
158 B	San Ildefonso, N. Mex	Aug., 1874	Dr. H. C. Yarrow and E. D. Cope.

CERATICHTHYS, Bd.

CERATICHTHYS BIGUTTATUS, Kirt.

PLATE XXIX, FIG. 1.

Semotilus biguttatus, KIRT., Bost. Jour. Nat. Hist., iii, 1840, 3, 44.
Ceratichthys biguttatus, GIR., P. R. R. Rep., Fishes, x, 1859, 253.—COPE, Cyprinidæ of Penna., Oct., 1866, 366, tab. xi, f. 5.—*Id.*, Proc. Am. Phil. Soc. Phila., 1874, 136.—*Id.*, Plagop. & Ichthy. Utah, 1874, 10.
Ceratichthys biguttatus var. *cyclotis*, COPE, Proc. Acad. Nat. Sci. Phila., 1864, 278.

As already noted, this common eastern species was unexpectedly discovered by Dr. H. C. Yarrow at Harmony, in Southern Utah, in 1872. Up to this time, the Smoky Hill River was the western limit of its distribution.

No.	Locality.	Date.	Collector.
P X	Harmony, Utah	Nov., 1872	Dr. H. C. Yarrow and H. W. Henshaw.

CERATICHTHYS PHYSIGNATHUS, Cope, *sp. nov.*

A large-scaled species, with slender body and wide, depressed head. The dorsal line is but little arched, and the profile of the muzzle descends steeply to the lip. The upper lip extends beyond the lower, and the maxillary bone reaches the line of the anterior border of the orbit. The beards are well developed, and the teeth number 4.2–2.4. Eye 4.6 in length of

head, 1.5 times in muzzle, and 1.75 in interorbital width. Length of head 3.6 in total length without caudal fin; greatest depth nearly five times in the same. Caudal peduncle stout. Scales, $\frac{5}{\frac{39}{4}}$; 23 rows in front of dorsal fin. Radii: D. I. 8; A. I. 8; V. 8. The dorsal fin originates in front of the line of the ventrals; the latter nearly reached the anal, but are not reached by the pectoral fins. Isthmus moderately wide. Color olive above, white below; a lead-colored band extending from the end of the muzzle to the base of the caudal fin; no basal caudal spot. Fins unicolor. Length, 2 inches.

No.	Locality.	Date.	Collector.
361	Arkansas River, at Pueblo.....	Oct., 1874	C. E. Aiken.

CERATICHTHYS STERLETUS, Cope, *sp. nov.*

PLATE XXVII, FIGS. 3, 3*a*.

A large-scaled species, well distinguished by its projecting muzzle, slender caudal peduncle, and large fins. The general form is slender, the greatest depth entering the total length six times; the length of the head entering nearly five times, or nearly four times without the caudal fin. The least depth of the caudal peduncle enters that of the body nearly three times. Teeth, 4–4. Barbels conspicuous. Muzzle very protuberant and broadly rounded; end of maxillary bone not reaching line of orbit. Isthmus moderately narrow. Orbit 4.5 times in length of head; 1.5 times in length of muzzle; 1.2 times in interorbital width. Scales, $\frac{6}{\frac{36}{5}}$. Radii: D. I. 8; A. I. 7; V. I. 8. Ventrals reaching line of first dorsal ray, but not the ventrals; the latter reach the anal. Caudal long and deeply forked.

In life this fish is silvery, with a few dusky scales; no color bands visible; top of head from orbits forward pink. Length, 0^{m}.075; length to base of dorsal fin, 0^{m}.030; to basis of caudal, 0^{m}.060. Not uncommon in the Rio Grande at San Ildefonso. Taken by H. C. Yarrow and E. D. Cope. It is to be compared with the *C. æstivalis* (*Gobio æstivalis*, Gir.), from Nuevo Leon, Mexico.

POGONICHTHYS, Gir.

POGONICHTHYS COMMUNIS, Gir.

Pogonichthys communis, GIR., P. R. R. Rep., x, 247, pl. lv.

A variable species, heretofore recorded only from the tributaries of the Missouri, but now obtained by Mr. Aiken in the upper waters of the Arkansas. The grinding surface of the pharyngeal teeth is only well developed in adults; in young up to four inches long it is often wanting; number 4.2–2.4. Scales from $\frac{6}{4}$ to $\frac{8}{5}$.

No.	Locality.	Date.	Collector.
279	Pueblo, Colo.....	July, 1874	C. E. Aiken.

HYPSILEPIS, Baird.

HYPSILEPIS IRIS, Cope, *sp. nov.*

PLATE XXXI, FIGS. 4, 4*a*, 5, 5*a*.

Dorsal fin above the ventrals; teeth, 4–4, with masticatory surfaces well developed; anal radii, I. 9.

This fish has the general characters of the species referred by Dr. Girard to the genus *Moniana*, but differs in the replacement of the pectinate edges of the pharyngeal teeth by grinding faces. It thus resembles the *Hypsilepides*, with which it also agrees in the forms of the scales and the coloration; but no known species of *Hypsilepis* exhibits but a single row of teeth. In *H. anolostanus*, there is but one of the lesser row, and it is certain that the number of such may be irregular in the same genus.

The present fish is, perhaps, the most brilliantly colored species of New Mexico. Outline shortly fusiform; body compressed; head entering length to basis of caudal three and three-fourths times; the greatest depth entering the same three and one-fourth times. Orbit entering length of head four times; interorbital width 1.5 times, and muzzle 0.8 time. Front and vertex of males bearing dermal tubercles. Mouth oblique; lips subequal; maxillary bone reaching line of orbit. Dorsal line well arched. Scales narrowly exposed on the sides, $\frac{5}{\frac{33}{3}}$; 17 rows in front of dorsal fin. Radii: D. I. 8; A. I.

9; V. 8; pectoral fin reaching ventrals; ventrals extending beyond first anal rays; dorsal and caudal fins short. Total length, 0m.068; length to basis of caudal fin, 0m.055; length to basis of first dorsal ray, 0m.030.

Color of back and upper part of sides malachite-green, sending a darker green band down behind operculum. Head and belly vermilion-red, sending upward a large quadrate vermilion spot behind the scapular green band. Paired and anal fins crimson; caudal vermilion; dorsal fin olivaceous.

Specimens of the above character were very abundant at San Ildefonso in September. At the same time, individuals were equally common, which differ from them in the uniform olive and silvery coloration, and in the usually one less ray in the anal fin. In eleven specimens selected at random, I find eight with anal radii I. 8, and three with I. 9. There are transitions to the other type, and I believe these forms to be the males and females of one species.

No.	Locality.	Date.	Collector.
156 ♂ and 159 ♀	San Ildefonso, N. Mex	Aug., 1874	Dr. H. C. Yarrow and Prof. E. D. Cope.

HYPSILEPIS JUGALIS, Cope.

Moniana jugalis, COPE, Ann. Rep. U. S. Geol. Surv. Terrs. 1870, 439.

General characters identical with type specimens from the Missouri River, but different in the existence of a masticating face on the teeth of adults, and the frequent occurrence of only I. 8 rays in the anal fin.

No.	Locality.	Date.	Collector.
A 1	Pueblo, Colo., on Arkansas River	July, 1874	C. E. Aiken.

HYBOPSIS, Agass.

Hybopsis, COPE, Synopsis of Cyprinidæ of Pennsylvania, 356–379.

HYBOPSIS TIMPANOGENSIS, Cope.

Hybopsis timpanogensis, COPE, Proc. Am. Phil. Soc. Phila., 1874, 134.—*Id.*, Plagop. & Ichthy. Utah, 1874, 10.

A rather compressed species, with mouth obliquely descending, and teeth 2.4–4.2, with strongly developed masticatory surfaces. The lateral

line of tubules is imperfect in all the specimens; often only represented by a short series in front of the dorsal fin. In larger specimens, it is better developed, and in still larger it may be complete, a point which remains as yet uncertain. In the smaller specimens of *Myloleucus parovanus*, the series is imperfect for a short distance in front of the caudal fin, while it is complete in adults. The same has been observed in the *Hypsilepis analostanus*, Girard. Scales small, $\frac{13}{52}$. The dorsal fin originates a little in front of a line drawn from the base of the first ventral ray. The pectorals do not reach the ventrals, while the latter attain the vent. Radii: D. I. 9; A. I. 8; V. 8.

The depth is one-fourth the length less that of the caudal fin, and the length of the head enters the same 3.66 times. Orbit 3.3 times in length of head, 1.2 times in interorbital width; longer than muzzle. Preorbital bone trapezoid. Total length, 0m.047; length to basis of dorsal, 0m.0215; of head, 0m.011; width at pterotics, 0m.005.

There is a narrow leaden line from the pterotic region to the base of the caudal, below which the color is yellowish and above brownish, all dusted with black points. Cheeks silvery. Fins dusky.

Numerous specimens were taken at Provo by Dr. H. C. Yarrow and H. W. Henshaw, and at Gunnison (No. 668) by F.. Klett and H. W. Henshaw.

The specimens taken at Gunnison were found in a small ditch having no visible inlet or outlet, situated about one mile from the Sevier River. The water in this ditch was stagnant and alkaline, yet it fairly teemed with these little fishes.

No.	Locality.	Date.	Collector.
666, 2	Provo, Utah	Aug., 1872	Dr. H. C. Yarrow and H. W. Henshaw.
668	Gunnison, Utah	do	Francis Klett.
48 B B	do	Sept., 1872	H. W. Henshaw.

HYBOPSIS SCYLLA, Cope.

Hybopsis scylla, COPE, Ann. Rep. U. S. Geol. Surv. 1870, 438 (var.).

Specimens agreeing in form of body, fin radii, squamation, and color with this species, but with a relatively longer head and larger orbit. Scales,

$\frac{6}{34}$; radii, D. I. 8; A. I. 7. Depth 4.6 in length without caudal fin; length of head four times in the same. Orbit one-third length of head, equal to interorbital width. Side of muzzle, top of head, and scales above lateral line dusted with black.

No.	Locality.	Date.	Collector.
52 E 1	Fountain Creek, Colo	July, 1874	John Yarrow.

GILA, Bd. & Gir.

Professor Cope has long been satisfied that the species included in the genera *Gila*, Bd. & Gir., and *Clinostomus*, Gir., by Girard, could not be retained in distinct genera, and that the greater number of the *Tigomæ* of the same author must be included in the same natural genus. Such a genus will then include *Cyprinidæ*, with the external series of teeth 5–4 of the raptorial type, and without grinding surface; no barbels; dorsal fin behind the line of the ventrals, without strong or separated spine. The typical *Gilæ* have a peculiar physiognomy, but the transition to the *Clinostomus* type is complete through *G. nacrea*, Cope, and *G.* (*Clinostomus*) *pandora*, Cope.

From the last to the large-scaled species, the transition is equally uninterrupted. The species of the genus then are the following:

Gila phlegethontis, Cope (*Clinostomus*).
Gila affinis, Girard (*Clinostomus*).
Gila funduloides, Girard (*Clinostomus*).
Gila margarita, Cope (*Clinostomus*).
Gila proriger, Cope (*Clinostomus*).
Gila tænia, Cope (*Clinostomus*).
Gila montana, Cope (*Clinostomus*).
Gila hydrophlox, Cope (*Clinostomus*).
Gila ardesiaca, Cope.
Gila humboldtii, Girard (*Tigoma*).
Gila pandora, Cope (*Clinostomus*).
Gila gula, Cope.

Gila nigra, Cope.
Gila egregia, Girard (*Tigoma*).
Gila nacrea, Cope.
Gila seminuda, Cope and Yarrow.
Gila gracilis, Baird and Girard.
Gila grahamii, Baird and Girard.
Gila elegans, Baird and Girard.
Gila robusta, Baird and Girard.

GILA PHLEGETHONTIS, Cope.

PLATE XXVII, FIGS. 4, 4*a*.

Clinostomus phlegethontis, COPE, Proc. Am. Phil. Soc. Phila., 1874, 137.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 11.

Teeth, 1.5–4.2. Body deep, short. Scales larger than in any other species of the genus, viz, eleven longitudinal and thirty-seven transverse series. There is no lateral line, which may be due to the immature state of the only specimen at my disposal. The depth enters the length without the caudal fin 3.5 times, while the length of the head is counted in the same four times. The orbit is large, entering the head 2.75 times, and 0.2 greater than interorbital width; in older fishes the orbit will be found, as usual, relatively smaller. The lips are even, and the mouth quite oblique; the end of the maxillary reaching the line of the orbit. Radii: D. I. 7; A. 1. 8; the ventrals originate in front of the line of the dorsal, and extend to the vent, and are not nearly reached by the pectorals. Length without caudal fin, $0^{m}.034$; length to basis of dorsal, $0^{m}.0186$; length of head, $0^{m}.008$; width of head at pterotics, $0^{m}.0038$. A broad plumbeous band on the side, below which the color is golden, above it is probably translucent in life, with a dusky median dorsal line.

Discovered in Beaver River, Utah, with the *Myloleucus parovanus*, by Dr. H. C. Yarrow and H. W. Henshaw; abundant.

GILA MONTANA, Cope.

Clinostomus montanus, COPE, U. S. Geol. Surv. Montana & Adjacent Territories, 1871, 476.—*Id.*, Proc. Am. Phil. Soc. Phila., 1874, 136.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 10.

Muzzle decurved, obtuse; jaws equal; end of maxillary extending

beyond margin of orbit. Orbit large, entering the head 3.5 times and the interorbital region once. Length of head one-fourth length to caudal fin; depth nearly equal. Scales, 11–12–56–6. Radii: D. I. 9; A. II. 12. Length, 3.5 inches.

Olive above, a dark band extending from epiclavicular region above caudal line to caudal fin. Sides crimson as high as lateral line. Differs from *C. hydrophlox* in the obtuse muzzle, large eye, and smaller scales above the lateral line.

Very abundant at Provo, Utah.

No.	Locality.	Date.	Collector.
44 B	Provo River, Utah	Nov., 1872	Dr. H. C. Yarrow.
555	Arizona!	... do	H. W. Henshaw.

GILA HYDROPHLOX, Cope.

Clinostomus hydrophlox, COPE, U. S. Geol. Surv. Montana & Adjacent Territories, 1871, 475.—*Id.*, Proc. Am. Phil. Soc. Phila., 1874, 133.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 7.

DESCRIPTION.—Length of head 4.75 times in total, exclusive of caudal fin; depth of body 4.5 times in same. Eye 5 times in head, 1½ times in interorbital width. Front straight; lower jaw projecting beyond upper; mouth descending; end of maxillary just reaching line of orbit. Isthmus narrow. Teeth 5.2–2.4. Scales, 15–58–7. Radii: D. I. 8; A. I. 11. Ventrals not reaching anal. Length 6 inches. Color above olive, with a blackish inferior border, extending from the superior margin of the orbit. Below this a crimson band, and still lower a blackish band, passing from the epiclavicular region above the lateral line to the basis of the caudal fin. Below this crimson in front, silvery behind. Fins unspotted. Suborbital bones crimson; cheek golden. This description is given for purposes of comparison.

GILA TAENIA, Cope.

PLATE XXVII, FIGS. 5, 5*a*.

Clinostomus tænia, COPE, Proc. Am. Phil. Soc. Phila., 1874, 133.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 7.

A smaller species than the last, distinguished by the smaller number of

anal radii, the elegant coloration, and other characters. Body of average proportions, its depth entering the length without caudal fin four and one-third times, and exactly equal to the length of the head. The head is compressed and the lips equal; the mouth is oblique, the end of the maxillary attaining the anterior line of the orbit. The orbit is large, entering the head three times and a fifth, and equaling the width of the convex interorbital space. Scales, $\frac{12}{58}$; 33 in front of dorsal fin. Lateral line complete, deflexed between pectoral and ventral fins. Radial formula: D. I. 9; A. I. 10; V. 9; P. 11; reaching ventrals, which reach vent. Dorsal first ray equidistant between the basis of the caudal and the anterior nostril.

Total length, 0m.073; length to anal fin, 0m.042; to ventral, 0m.031; length of head, 0m.014; length to orbit, 0m.0036; width to posterior nostrils, 0m.004; width at middle of pterotic, 0m.0062. The sides are pure silvery to the lateral line of pores, above which a blackish vitta extends from the end of the muzzle to the caudal fin. Above this is a narrow very white line, which extends to the base of the caudal fin, and above this the entire dorsal region is blackish. Fins unspotted.

Numerous specimens from Provo near the lake (No. 667,667 S., and 666). Collected by Dr. H. C. Yarrow and H. W. Henshaw.

This little fish is called by the Mormon settlers Silver-side or Leather-side Minnow, and is very common in Provo River. Is from three to five inches in length; male of an iridescent green color, blackish back. Silvery stripe commencing just above middle third of body; just below a bright orange yellow stripe, and under this a fine black stripe. Belly white; iris black; female without the bright lines, and much larger. This beautiful little fish is very abundant in the rocky holes of the Provo River, and is the favorite food of the trout, inhabiting the same locality. They are found on the whole course of the river, from just below the fall, in Provo Cañon, to the mouth, but strange to say are seldom seen in Lake Utah, into which this river empties.

We are inclined to believe that the trout *Salmo virginalis*, as mentioned previously, visit the mouth of the river not only to get into cooler water, but to feed upon these minnows. Their spawning time is early in

June, and at this period they are extremely wary, and are caught with difficulty. They run up the river, returning late in July. After an entire morning's labor, we succeeded in taking only about two dozen, notwithstanding we used three different kinds of nets. It is said that the male fish constructs the nest displacing pebbles and gravel by convulsive movements of the body, and that after the eggs are deposited watches over them. We know by personal experience that this watch is carefully kept up, as we have driven fish away from certain localities with our net, and in a few minutes found the same individuals to return.

In the stomach of the trout of Provo River, we have found eight or ten of these fishes.

Also found in Beaver River, Middle Utah.

GILA ARDESIACA, Cope, *sp. nov.*

PLATE XXX, FIGS. 1, 1*a*.

The *Gila ardesiaca* is a fish of the compressed form, characteristic of *G. hydrophlox*, and the mouth is short and directed obliquely upward. The muzzle is short, but not descending, and is not longer than the diameter of the large eye. Scales, $\frac{17}{63}$; anal radii, I. 8. Base of first dorsal ray measuring $\frac{}{8}$ the middle point between the basis of the caudal fin and the posterior border of the orbit. Pectoral fin with enlarged radii, nearly reaching the ventral; the latter not quite reaching anal orbit one-fourth of length of head, equal to the interorbital width. Head 3.5 times in length to basis of caudal fin; greatest depth 4.2 in the same. Dental formula 4.2–2.5.

Olive above, with a lead-colored band from the upper canthus of the branchial fissure to the base of the caudal fin; head dusky; the operculum steel-blue. Length, $0^{m}.095$. Locality of the single specimen unknown.

This fish is of the same group as the *G. montana*, but from this and the *G. hydrophlox* it differs in the shorter anal fin with but few rays.

GILA PANDORA, Cope.

Clinostomus pandora, COPE, Ann. Rep. U. S. Geol. Surv. Terrs., 1871, 475.

This is the common chub or pescadito of the Rio Grande and its tribu-

taries, and is the most abundant fish in New Mexico It is a variable species, frequently exhibiting a dental formula of 4.1–1.4; indeed, usually so in small or immature individuals. The second tooth frequently displays a small grinding face. The variation in squamation is given below.

Var. I. Scales, $\frac{18}{65}$; eye six times in head, twice in interorbital width; form stout.

No.	Locality.	Date.	Collector.
207	Pagosa, Colo	Sept., 1874	C. E. Aiken.

Var. II. Scales of lateral line 59–63; eye 4.75 in head, 1.5 in interorbital width.

Teeth 4–5 and 4–4 in external row; scales, $\frac{19}{63}$.

No.	Locality.	Date.	Collector.
107	Rio Grande, mouth of Rio Honda	Aug., 1874	Prof. E. D. Cope.

Scales, $\frac{17}{59}$.

No.	Locality.	Date.	Collector.
(?)	Rio Grande, near San Ildefonso, N. Mex		Dr. H. C. Yarrow.

GILA GULA, Cope, *sp. nov.*

PLATE XXX, FIGS. 2, 2*a*.

Allied to the last, and similar in squamation, but distinguished by a robust habit, especially a large head, with wide front and wide mouth. The eye enters the side of the head five times, and the interorbital width twice. Head only three and one-half times in length, exclusive of caudal fin; the same is one-fourth this length in *G. pandora*. The depth enters the same in *G. gula* four and two-thirds times. Teeth, 4.2–2.5. Scales, $\frac{16}{60}$. Radii:

D I. 8; A. I. 8. First ray of dorsal half way between base of caudal fin, and posterior border of orbit. Total length, 7 inches ($0^{m}.17$). Color dusky-olive to below the lateral line; belly silvery; axils of fins crimson. Region between the lateral line and pectoral fin dusky to beyond the ventrals.

No.	Locality.	Date.	Collector.
44	Rio de Acama	July, 1874	H. W. Henshaw.
44 A	Near Fort Wingate, N. Mex	do	Do.

GILA EGREGIA, Cope.

? Gila egregia, GIR., *? Tigoma egregia*, GIR., P. R. R. Rep., x, 1859, 291.
Hybopsis egregius, COPE, Ann. Rep. U. S. Geol. Surv. Terrs. 1870, 438.
Alburnellus ?, COPE, Proc. Am. Phil. Soc. Phila., April, 1874, 133.

An abundant species in the Rio Grande, much resembling the *G. pandora*, but differing constantly in the smaller and more numerous scales. In two specimens, they number $\frac{17}{\frac{8}{11}}$ and $\frac{18}{\frac{7}{9}}$. The head enters the length without the caudal fin four times. The outer rows of pharyngeal teeth are often 4–4, but 5–4 in large specimens. Abnormal developments of the teeth are common in the young specimens of this fish from the Rio Grande. Thus, by the incurvature of the external row, I found the teeth to count (No. 1) 3.3.1–3.2.2–1.4.3–2.2.3–2.4.2, and unsymmetrical.

This species is represented in the collection, also, by a great number of individuals from the Beaver River, Utah, visited by the expedition. These compare favorably with Girard's descriptions. Scales, $\frac{18}{\frac{7}{9}}$. Anal radii, 1–8–7. Teeth, 2.4–4.2. Very abundant in pools of the river.

No.	Locality.	Date.	Collector.
30	Beaver River, Utah	Aug., 1872	Dr. H. C. Yarrow and H. W. Henshaw.
26	do	Sept., 1872	Do.
281	do	do	Do.
31	do	Nov., 1872	Dr. H. C. Yarrow.
204	Loma, Rio Grande, Colo	Oct., 1873	Dr. J. T. Rothrock.

GILA NIGRA, Cope, *sp. nov.*

PLATE XXX, FIGS. 3, 3*a*.

This species, which is represented by a number of specimens in the collection of the survey, resembles those last enumerated, and differs from the *G. pandora* in the considerably more numerous scales; from the *G. egregia* it differs in the relatively larger head, which enters the length minus the caudal fin only three and one-half times, instead of four times. The dental series is found to be in several specimens 4.2–2.5. Scales, $\frac{21}{87}, \frac{20}{78}, \frac{20}{86}, \frac{}{12}, \frac{}{11}, \frac{}{11}$, in three specimens. General shape fusiform; profile gradually descending, then decurved to the upper lip, which overhangs the lower by a little; mouth slightly descending. Teeth, 4.2–2.5; isthmus rather wide. Eye not large; in adults six times in length of head, 1.75 times in muzzle, and twice in interorbital width. The fins are all rather small, including the caudal; the pectorals reach 0.6 the distance to the ventrals, and the latter 0.6 the distance to the anal. Radii: D. I. 8; A. I. 8; V. 9. Least depth of caudal peduncle 2.6 times into greatest depth (in front of dorsal fin), which enters the length without the caudal fin four times. Total length, 0^{m}.235 (7¼ inches); length to basis of first dorsal ray, 0^{m}.113; length to basis of caudal fin, 0^{m}.200.

General color black. Lower surfaces olive.

No.	Locality.	Date.	Collector.
204	Ash Creek, Ariz	July, 1874	Dr. J. T. Rothrock.
1019	San Carlos, Ariz	Oct., 1874	H. W. Henshaw.

GILA ROBUSTA, Bd. & Gir.

Gila robusta, BD. & GIR., Proc. Acad. Nat. Sci. Phila., vi, 1853, 369.—*Iid.*, Sitgreave's Exp. Zuñi & Col. Riv., 1853, Fishes, 148, pl. 1, f. 1.—*Iid.*, P. R. R. Rep., x, 1857, Fishes, 285.

A comparison of two good specimens with Baird and Girard's description reveals some trifling differences with regard to number of radii. Specimen No. 504, from Zuñi River, New Mexico, has the following formula:

Br. 3 on each side; D. 1–10; A. 1–11; C. 8–1–8–8–1–8; V. 1–8; P. 13; teeth 4.1–5.2. In this specimen, the head enters the total length including caudal fin 4.50 times; eye entering length of side of head 7 times; base of anal fin 11.50 in total length.

Specimen No. 504 A, from same locality, has: Br. 3–3; D. 1–11; A. 1–10; C. 8–1–8–8–1–7; V. 1–8; P. 13; teeth 4.2–4.2. Head enters total length 4.50 times; eye in length of side of head 7.75; base of anal fin 10.50 of total length. All the individuals of this species which have been examined possess on the end of the snout a little behind its anterior margin and on the median line of the head, a peculiar knob or tubercle, which is more plainly visible in alcoholic than fresh specimens. *Gila gracilis* possesses it in a much less marked degree.

No.	Locality.	Date.	Collector.
45	Arizona	——, 1871	F. Bischoff.
8XXX	do	do	Do.
504	Zuñi River, N. Mex.	July, 1873	H. W. Henshaw.
504 A	do	do	Do.
2 A 2	Gila River, Ariz	Sept., 1873	Do.

GILA ELEGANS, Bd. & Gir.

Gila elegans, Bd. & Gir., Proc. Acad. Nat. Sci. Phila., vi, 1853, 309.—*Id.*, Sitgreave's Exp. Zuñi & Col. Riv., 1853, 150, pl. ii.—Gir., Proc. Acad. Nat. Sci. Phila., viii, 1856, 205.—*Id.*, U S. & Mex. Bound. Surv., pt. ii, 1859, Ichthyology, 61.—Cope, U. S. Geol. Surv. Terr., 1870, 441.

This species, resembling the preceding, but more elongated in form, and having larger scales, has been but sparingly observed by the members of this expedition; the only specimen having been brought from Southwestern Arizona by F. Bischoff of the expedition of 1871. This is in such bad condition that the distinctive characters can hardly be made out.

No.	Locality.	Date.	Collector.
54 Z	Southwestern Arizona	——, 1871	F. Bischoff.
381 A	San Juan River, N. Mex.	——, 1874	Lt. R. Birnie.

GILA GRACILIS, Bd. & Gir.

Gila gracilis, BD. & GIR., Proc. Acad. Nat. Sci. Phila., vi, 1853, 369.—*Iid.*, Sitgreave's Exp. Zuñi & Col. Riv., 1853, Fishes, 151, pl. iii.—GIR., Proc. Acad. Nat. Sci. Phila., viii, 1856, 205.—BD. & GIR., P. R. R. Rep., x, 1859, Fishes, 287.—GIR., U. S. & Mex. Bound. Surv., pt. ii, Ichthyology, 1859, 61.—COPE, U. S. Geol. Surv. Terr., 1870, 441.

A number of specimens of this species have been obtained which correspond very nearly with the description given by Baird and Girard.

In two specimens, 570 and 571, from White River, Arizona, the teeth formulæ are as follows: 4.2–5.2—5.2–5.2. The head enters total length 4.25 times; the eye in length of side of head 6 times; the base of anal fin 9.25 times of total length including caudal. Radii: D. 2–9; A. 3–9; C. 8–1–10–8–1–11; V. 1–9; P. 16. This species is intermediate in form between *Gila robusta* and *Gila elegans*, and the scales are smaller than either; is found abundant in many of the deep pools of streams of Arizona; is sluggish in habits, and may be readily taken by hook baited with almost any substance, pork, grasshopper, or even a piece of fish. Many were taken by seine also. Are an excellent food fish, flesh being firm, but so full of bones as to render it hazardous to eat without care. These fishes are extremely hostile to the trout (*Salmo pleuriticus*), driving them and other fishes to the shallower and more rapid parts of the streams if they approach them. No female taken in roe.

No.	Locality.	Date.	Collector.
570	White River, Ariz	Aug. 12, 1873	H. W. Henshaw.
606	do	Aug. 23, 1873	Do.
571	do	do	Do.

GILA GRAHAMII, Bd. & Gir.

Gila grahamii, BD. & GIR., Proc. Acad. Nat. Sci. Phila., vi, 1853, 389.—GIR., Proc. Acad. Nat. Sci. Phila., viii, 1856, 205.—*Id.*, U. S. & Mex. Bound. Surv., x, pt. ii, Ichthyology, 1859, 61, pl. xxiv, figs. 7–12.—COPE, U. S. Geol. Surv. Terr., 1870, 441.

A number of specimens of this beautiful species was secured during the expedition in different parts of Arizona and New Mexico; notably in the White River, near Camp Apache, a branch of the Gila. After an exam-

ination of specimens, they have been found to correspond better with Girard's description than any other species of this genus. Is found abundant in same stream as preceding.

No.	Locality.	Date.	Collector.
64	Camp Apache, Ariz	June, 1873	Dr. O. Loew.
65	..... do	..... do	Do.
5	Colorado Chiquito, N. Mex	July, 1873	Dr. C. G. Newberry.
653 C	White River, Ariz	Aug. 29, 1873	Dr. O. Loew.
653 A C	..... do	..... do	H. W. Henshaw.
43-	..... do	July, 1874	Jas. M. Rutter.
54	Zuñi River, N. Mex	..... do	H. W. Henshaw.
204 A	Ash Creek, Ariz	..... do	Dr. J. T. Rothrock.
1269	Gila River, Ariz	Aug., 1874	Jas. M. Rutter.
910	(?)	..... do	Dr. J. T. Rothrock.

GILA NACREA, Cope.

Gila nacrea, COPE, U. S. Geol. Surv. Terr., 1870, 441.

This species is closely allied to the foregoing, but differs in a less depressed cranium and much larger eye. The head is very nearly like that of *Ceratichthys* and other ordinary *Cyprinidæ*. From Green River, Wyoming.

GILA SEMINUDA, Cope & Yarrow, *sp. nov.*

PLATE XXXI, FIGS. 1, 1*a*.

This species is established upon a number of specimens secured from the Rio Virgen River, an affluent of the Colorado; the exact locality where taken being a little south of Washington, Southern Utah. The species is by no means scarce, as several hundreds were observed captured by boys with hook and line. This species is closely allied to *G. nacrea*, Cope, but has a larger eye and shorter head.

Radii: D. 2–10; C. 34; A. 1–10; V. 10; P. 15. Teeth, 5.2–2.4. Scales, 21–12, small and subcircular; none on belly. Length of head 5 times in total length, including caudal. Depth at dorsal fin 5.75 of total length. Ventral fins originating slightly in advance of dorsal fin. Least

depth of caudal peduncle 3⅓ times into depth at ventral. Profile and interorbital region slightly convex; width of latter 3 times in length of head. Diameter of eye 4 times in greatest length of head and 1.1 times in length of muzzle. End of maxillary not reaching posterior rim of orbit. Total length, 0.140 meter. Color purplish-brown on dorsal region; lower fins fins yellowish-pink.

GILA EMORII, Bd. & Gir.

Gila emorii, BD. & GIR., Proc. Acad. Nat. Sci. Phila., vi, 1853, 388.—GIR., Proc. Acad. Nat. Sci. Phila., viii, 1856, 205.—*Id.* U. S. & Mex. Bound. Surv., ii, Ichthyology, 1859, 62.

This beautiful species, resembling *G. grahamii*, although said to be numerous in the Gila River, was not brought in by survey, but it is believed numbers were taken with the other species of *Gila* in that stream.

SIBOMA, Gir.

Proc. Acad. Nat. Sci. Phila., 1856, 208.

SIBOMA ATRARIA, Gir.

Siboma atraria, GIR., Proc. Acad. Nat. Sci. Phila., viii, 1856, 208.—*Id.*, P. R. R. Rep., x, 297, 277.—COPE, U. S. Geol. Surv. Montana & Adjacent Territories, 1871, 475.—*Id.*, Proc. Am. Phil. Soc. Phila., 1874, 132.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 10.

The specimens in our collection correspond well with Girard's description, except that in some instances we find the dorsal fin to have 10 rays; the ventrals 9.

Very abundant in streams throughout entire Rocky Mountain basin. This species is very common in Utah Lake, and is called by the Mormon settlers in Utah the Mullet, but resembles in no wise the well known marine form. Although not specially fished for, great numbers are taken every year in the trout nets.

In summer, the flesh is soft and insipid; but in the cold months of the year, it is firm and well-flavored, and they are sold to a considerable extent in the Salt Lake City market, the price being, as an average, about three cents per pound. They spawn in April, and run up the rivers, returning in June.

Do not often take the hook, except when baited with grubs, of which food they are fond. Feed on the bottom and are sluggish in their movements. Largest seen weighed seven pounds, and were twenty inches long, but will average only one pound apiece. Many of these fishes, which must eventually become of considerable importance to the settlers, are simply wasted; little care being taken to return them to the water when not wanted, a practice which should be prevented by law.

No.	Locality.	Date.	Locality.
218	Iron Springs, Utah	Aug., 1872	Dr. H. C. Yarrow.
500	Utah Lake, near Provo, Utah	.... do	Dr. H. C. Yarrow and H. W. Henshaw.
501	..... do	.... do	Do.
502	..... do	.... do	Do.
139	Gunnison, Utah	Sept., 1872	H. W. Henshaw.
66 X	Denver, Colo	May, 1873	Do.
504 A	Zuñi, N. Mex	July, 1873	Do.
503	..... do	.... do	Do.
503 X	..... do	.... do	Do.
505	..... do	.... do	Do.
505 P	Colorado Chiquito, N. Mex	——, 1873	Do.
505, 2	..... do	——, 1873	Do.

SIBOMA ATRARIA var. LONGICEPS, Cope.

PLATE XXIX, FIG. 4.

This form differs from the typical in having the head longer and the scales larger. Scales, $\frac{12}{56}$. Colors same as *S. atraria.*

This variety was discovered by Dr. H. C. Yarrow in Snake Creek Valley, Nevada, who remarked that, while very abundant and the only species of this creek, in Schell Creek Valley, not far distant, no fishes whatever are found. The conditions of life being apparently similar in both streams, their difference in this respect was not explained.

No.	Locality.	Date.	Collector.
312	Snake Creek, Nev	Aug., 1872	Dr. H. C. Yarrow.
121	....do....	....do....	Do.
5 F	....do....	....do....	Do.
5 D	....do....	....do....	Do.
240	Utah	——, 1872	Do.
507	Virgen River, Utah	Oct., 1872	Do.
5 E	Colorado Chiquito, N. Mex	Sept., 1873	Dr. C. G. Newberry.

MYLOLEUCUS, Cope.

A new genus, established by Professor Cope in 1871 upon specimens received from Warm Springs, Utah.

"Teeth raptorial, but with well-developed masticatory surface; 5–4 in outer row. No barbels; lateral line well-developed. Dorsal fin above or in front of line of ventrals. This genus is *Siboma*, with developed grinding surfaces of the teeth."

MYLOLEUCUS PULVERULENTUS, Cope.

Myloleucus pulverulentus, COPE, U. S. Geol. Surv. Montana & Adjacent Territories, 1871, 475.

Seen by members of the survey, but no specimens received in Washington.

MYLOLEUCUS PAROVANUS, Cope.

Myloleucus parovanus, COPE, Proc. Am. Phil. Soc. Phila., 1874, 136.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 10.

PLATE XXVIII, FIGS. 3, 3*a*.

With a general similarity to *Gila montana*, this fish may be readily determined by the generic characters of the teeth and fins, as well as by the reduced number of radii of the anal fin. The genus *Myloleucus* was established, as already noted, in 1871, for species resembling *Siboma*, in having the pharyngeal teeth of the longer row 4–5, and the origin of the dorsal fin situated in advance of the ventral, but differing in the possession of well defined masticatory surfaces on the teeth. The typical species of *M. pulverulentus*, Cope, is from the Warm Springs of Utah; a fish which differs from the present one in the greater stoutness of form and smaller and more numerous scales.

Form moderately stout; muzzle short, conical; lips even; mouth very oblique, maxillary bone reaching anterior line of orbit. Profile of head and back gently arched. Depth of body equal length of caudal fin, and measuring 4.25 in the total length, less that fin; length of head 3.5 or 6 times in the same. Orbit large, 3.1 times in length of head; greater than muzzle; equal interorbital width. Scales, $\frac{11}{48}$; the lateral line decurved in front, and continued to base of caudal fin. Radii: D. I. 9; A. I. 8; V. 9. The pectorals reach little more than half way to the ventrals; the latter just attain the vent. Caudal well forked. The color is transparent, with a plumbeous lateral band; the ventral and pectoral fins dusky; the dorsal and caudal shaded with the same. Total length, 0m.0648; length to base caudal, 0m.053; to anal, 0m.038; to ventral, 0m.0288; length of head, 0m.014; length to orbit, 0m.003; width at middle pterotics, 0m.0064.

Numerous specimens were obtained by Dr. H. C. Yarrow and H. W. Henshaw from Beaver River, in Southwestern Utah. This stream flows into the Sevier Lake, a very alkaline body of water, in which no fishes were found by the naturalists of the survey.

The two species indicated are thus far the only ones of the genus known.

No.	Locality.	Date.	Collector.
90	Beaver River, Utah	Sept., 1872	Dr. H. C. Yarrow and H. W. Henshaw.
666 O	do	do	Do.

HYBORHYNCHUS, Agass.

HYBORHYNCHUS SIDERIUS, Cope, *sp. nov.*

PLATE XXXI, FIGS. 6, 6*a*.

A fusiform species with a rather small acuminate head and with small scales. The physiognomy is quite distinct from that of the known species of this genus, resembling rather an *Apocope*. The teeth are of typical character, and the intestines are very elongate, and the peritoneum black.

Greatest depth equal to length of head and one-fourth of total length without the caudal fin. Mouth terminal; upper jaw overlapping; maxillary bone reaching line of orbit. Profile gently descending from nares. Mouth more than a semicircle; lower jaw hard, but not so attenuated as in the species of *Hybognathus*. Eye not large, 4.1 times in length of head, 1.3 times in muzzle and interorbital width. First dorsal ray above first ventral. Radii: D. I. 8; A. I. 7; V. 8, reaching anal; pectorals extending 0.66, the distance to the ventrals. Dorsal and anal fin long. Dorsal nearer the end of the muzzle than the caudal fin; caudal fin short. Scales, $\frac{17}{88}$, present on median lines above and below.

Color dark iron-gray above (whence the name); a darker band of the same along the side above the lateral line, extending to the end of the muzzle, and through the caudal radii to the notch of that fin. Total length, 0.84; length to basis of caudal fin; 0.70; length to first dorsal ray, 0.33.

The plate affords a view in profile of the species and of the ventral aspect.

No.	Locality.	Date.	Collector.
625	Camp Lowell, Ariz.....	Sept., 1874	Jas. M. Rutter.

HYBORHYNCHUS NIGELLUS, Cope, *sp. nov.*

This Cyprinoid resembles a *Pimephales*, but possesses a complete lateral line. Teeth, 4–4. Alimentary canal elongate, less so than in the *H. siderius*.

Scales narrowly exposed, $\frac{8-9}{43}$. Form stout with moderately convex dorsal outline; head wide, the muzzle abruptly truncate. Mouth terminal, very small, oblique; the end of the maxillary not reaching the line of the orbital border. Diameter of eye one-fourth length of head, one-half interorbital width, and a little less than length of muzzle. Two osseous ridges on front, each extending backward from inner posterior border of nares; another short one above each postorbital region. Length of head entering total without caudal fin 3.8 times, and equal to greatest depth of body. Isthmus moderately wide. Radii: D. I. 8; osseous ray very distinct, as in other species; A. I. 7; V. 8. The fins are small; but while the pectoral does not reach the ventral, the latter reach the anal.

Total length, 0.060; length to basis of caudal, 0.048; length to first dorsal ray, 0.025. Color dark-olive; a blackish lateral band; scales above it edged with dusky; a black vertebral band; head, except lower aspect, black; anterior border of pectoral, both borders of anal, and a strong median band through the dorsal fin, black.

Several specimens from the Arkansas River at Pueblo, Colo., from C. E. Aiken.

Numerous individuals from the same locality differ in having a less truncate muzzle and a much smaller anal fin; the radial and scale formulæ are the same. I suppose these to be females of the present species.

HYBOGNATHUS, Agass.

HYBOGNATHUS NUCHALIS, Agass.

Hybognathus nuchalis, COPE, Proc. Am. Phil. Soc. Phila., 1870, 466.

Abundant in the Rio Grande; one of the few eastern species occurring west of the Rocky Mountain range.

No.	Locality.	Date	Collector.
164	San Ildefonso, N. Mex	Aug., 1874	Dr. H. C. Yarrow and Prof. E. D. Cope.

CAMPOSTOMA, Agass.

CAMPOSTOMA AIKENII, Cope, *sp. nov.*

A true species of this genus, exhibiting the characteristic convolution of the alimentary canal around the natatory bladder, from the Upper Arkansas River, is represented by a small specimen. Form attenuated; muzzle conic; mouth terminal, small. Head 3.75 times in length without caudal fin; depth 4.75 times in the same. Eye 4.25 times in head, 1.5 times in both interorbital width and length of muzzle. The fissure of the mouth only reaches to the anterior nareal opening. The fins are small, the dorsal stending immediately over the ventral. Radii: D. I. 8; A. I. 7. Total length, 0.052; length to origin of caudal fin, 0.042; to basis of dorsal fin, 0.022. Color above dusky-olive; a dark lateral band from end of muzzle to base of caudal fin; below silvery.

The species is dedicated to Chas. E. Aiken, of Colorado Springs, an industrious naturalist, who has made a number of interesting discoveries in various departments of zoölogy.

One specimen; Pueblo, Colo.; Chas. E. Aiken.

CATOSTOMIDAE.

PANTOSTEUS, Cope.

Professor Cope, in 1870, purposed to adopt as valid seven genera of this family; but, in 1872, he stated his belief that an eighth should be added, which should embrace species combining the characters of *Catostomus* proper, a complete union of the parietal bones, which obliterates the fontanelle so universal among the suckers; the only other exception being seen in *Cycleptus*, Raf., as he has already observed. In all the members of the family that he has examined in this regard, the fontanelle has been found quite open and of no doubtful proportions, and is nowhere reduced to the slit often seen in the *Siluridæ*, unless it be in the *Catostomus discobolus*. In searching for the characters of Girard's supposed genera *Minomus* and *Acomus*, he expressed the view that the type of the former, *M. insignis*, Baird and Girard, presents the character in question. This conclusion was based on a specimen sent to the Academy of Natural Sciences from Washington bearing this name. Having since then examined five specimens of the *M. insignis*, obtained by the zoölogists of this survey, he finds them to be true *Catostomi*, as determined by the presence of the fontanelle. It therefore appears that this genus requires a name, and he proposes for it that of *Pantosteus*. It embraces the following species: *P. platyrhynchus*, *P. jarrovii*, and *P. virescens*, Cope, of the present essay; *P. delphinus* and *P. bardus*, Cope, Hayden's report, *l. c.*

PANTOSTEUS PLATYRHYNCHUS, Cope.

PLATE XXIX, FIGS. 3, 3*a*.

Minomus platyrhynchus, COPE, Proc. Am. Phil. Soc. Phila., 1874, 134.—*Id.*, Plagop. & Ichthy. Utah, 1874, 8.

This Catostomoid is of very elongate form; the depth of the body at the dorsal fin entering the total length seven and two-fifths times. The head is short and wide, with expanded and depressed muzzle; its length enters

the total five and three-fourths times. The scales are materially larger on the caudal peduncle than on the post-scapular region, and the dorsal fin originates considerably nearer the end of the muzzle than the basis of the caudal fin. Radial formula: D. I. 11; C. 18, openly emarginate; A. I. 7; V. 9, not reaching vent; pectoral reaching half way to ventral. Scales, $\frac{15}{56}$. The orbits are excavated at their superciliary border, and their diameter enters their frontal interspace 1.66 times, and the length of the head 4.6 times, twice in the length of the muzzle in front of its border. The muzzle considerably overhangs the mouth. The lip folds are tubercular and largely developed, forming a discoidal funnel. The posterior is deeply incised behind; and there is a notch where it joins the anterior lip. The commissure is transverse and abruptly angulate to the canthus, and covered with a cartilaginous sheath as in *Chondrostoma*. Isthmus very wide.

Total length, 0^{m}.168; length to basis of caudal, 0^{m}.149; length to basis of ventral, 0^{m}.082; length to basis of dorsal, 0^{m}.070; length of head, 0^{m}.029; width of muzzle at mouth, 0^{m}.015; width of head at pterotics, 0^{m}.0156. Color blackish; belly and ventral fins yellowish (? pink). This species resembles the *Catostomus discobolus*, Cope, but has larger scales, besides presenting generic differences. Several specimens from near Provo. Collected by Dr. H. C. Yarrow and H. W. Henshaw.

No.	Locality.	Date.	Collector.
48	Provo River, Utah	Nov., 1872	Dr. H. C. Yarrow and H. W. Henshaw.

PANTOSTEUS JARROVII, Cope.

PLATE XXIX, FIGS. 2, 2*a*.

Minomus jarrovii, COPE, Proc. Am. Phil. Soc. Phila., 1874, 135.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 9.

A less elongate species than the last, with a much less enlarged muzzle. The anterior scales are smaller than the posterior, and the first dorsal ray is nearly intermediate between the end of the muzzle and the basis of the caudal fin. Radii: D. 9; C. 18; A. I. 7; V. 9, well removed from both vent and pectoral fin. Depth at dorsal fin 5.75 times in total length, into

which the length of the head enters 5.3 times; orbit small, 4.6 times in length of head, twice in interorbital width, and 1.75 times in muzzle; the latter projecting a little beyond mouth, not depressed, but narrowed viewed from above. Labial folds well developed, tubercular, the anterior rather narrow, the posterior deeply incised. Commissure with acute cartilaginous edge, regularly convex forward. Scales, $\frac{14}{85.}{}^{14}$.

Total length, 0m.107; length to basis of caudal, 0m.0933; length to basis of ventral, 0m.052; length to basis of dorsal, 0m.047; length of head, 0m.0205; width of muzzle at mouth, 0m.075; width of head at pterotics, 0m.011.

Color light-brown, with numerous dusky spots and clouds; a narrow abdominal band light; fins and chin (?) red.

Two specimens of this species were obtained by the expedition of 1873 in the Zuñi River, a tributary of the Colorado. In 1874, we found it very abundant in the tributaries of the Rio Grande as far as we explored it, *i. e.*, from Fort Garland, Colo., to Santa Fé. It is the prevalent Catostomoid of that river basin, and is everywhere associated with the *Salmo pleuriticus* and *Gila pandora*, &c. It imitates the coloration of the former in having a broad crimson band along the middle of each side in spring and summer. Below this there is frequently a broad blackish band. The scales below the lateral line vary from 11 to 14, and those on the line from 80 to 87. The dorsal fin rarely has 10 rays.

The species was dedicated to Dr. H. C. Yarrow in recognition of his important services to zoölogical science.

No.	Locality.	Date.	Collector.
504	Zuñi River, N. Mex	June 12, 1873	H. W. Henshaw.
126 A	Costilla, N. Mex	Aug., 1874	Prof. E. D. Cope.
111	Taos, N. Mex	..... do	Dr. H. C. Yarrow.
240	San Ildefonso, N. Mex	..... do	Dr. H. C. Yarrow and Prof. E. D. Cope.
227	Tierra Amarilla, N. Mex	Sept., 1874	Dr. H. C. Yarrow and W. G. Shedd.

PANTOSTEUS VIRESCENS, Cope, *sp. nov.*

An elongate fish, with short, wide head and compressed body; the caudal peduncle rather contracted. Muzzle obtuse, projecting but little

beyond the upper lip. Upper lip moderately wide, pendent, furnished with three rows of small tubercles. Posterior lip full, with a strong median emargination, and entering angle at junction with anterior lip; tubercles numerous, small. Orifice of mouth large, slightly curved; tomia with smooth borders. As the specimen is adult, the eye is relatively small, entering the length of the head seven times and the interorbital width 3.5 times. The length of the head enters the total (with caudal fin) six times.

The scales are much larger on the caudal peduncle than on the anterior parts of the body, and number $\frac{18}{103.}{}_{16}$. Fin radii: D. I. 10; A. 7; V. 9; pectorals not reaching half way to ventrals; the latter 0.75 the distance to the anal fin. Emargination of caudal fin distinct, shallow. Dorsal a little nearer basis of caudal than end of muzzle. Eleven longitudinal rows of scales on caudal peduncle.

Color in spirits olivaceous; decidedly green on the head; lower surfaces and fins (narrowly on belly) yellow. Total length, 0^{m}.365; length to dorsal fin, 0^{m}.150; length to caudal fin, 0^{m}.307.

One species accompanying an *Amiurus*, which is marked Arkansas River, at Pueblo, Mr. C. E. Aiken.

CATOSTOMUS, Les.

CATOSTOMUS INSIGNE, Bd. & Gir.

Catòstomus insigne, BD. & GIR., Proc. Acad. Nat. Sci. Phila., 1854, 28.
Minomus insignis, GIR., U. S. & Mex. Bound. Surv., ii, Ichthyology, 37, 37, pl. xxi, figs. 1–4.

This species is a true *Catostomus*, and the fine adult specimens all exhibit the characteristic fronto-parietal fontanelle. Scales, $\frac{11}{68}{}_{9}$; radii, D. I. 11; A. 7; V. 9.

No.	Locality.	Date.	Collector.
1270	Ash Creek, Ariz	July, 1874	Dr. J. T. Rothrock.
L 400	"New Mexico"	Aug., 1874	Dr. O. Loew.

CATOSTOMUS ALTICOLUS, Cope.

Catostomus alticolus, COPE, Proc. Am. Phil. Soc. Phila., 1874, 138.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 12.

A stout, rather short species of sucker, with elongate head and narrowed muzzle. The scales are larger behind than anteriorly, and number sixty transverse and nineteen longitudinal rows. The radial formula is: D. 10; C. 18; A. 7; V. 10, originating below the middle of the dorsal fin, and neither extending to the vent nor reached by the pectoral fin; caudal with shallow emargination. The depth enters the length with caudal five times, which is three and two-thirds the length of the head. Orbit 4.33 times in head, 1.66 times in interorbital width. The muzzle is long (1.66 times orbit), but is not produced much beyond the mouth, but is truncate and narrowed viewed from above. Lip folds well developed; the superior pendant; the inferior full but incised to the symphysis; the surfaces tubercular. Vertex flat.

Total length, 0^{m}.0863; length to origin of caudal fin, 0^{m}.070; to origin of anal, 0^{m}.0546; to origin of dorsal, 0^{m}.0365; width of head at posterior nares, 0^{m}.008; at middle of pterotics, 0^{m}.010. Color silvery; upper part of sides and back dusky. In specimens of this size, the lateral line is invisible; but in adults of eight inches obtained by Mr. J. S. Lippincott, it extends to the basis of the caudal fin.

Numerous specimens from Twin Lake, Colorado, obtained by Dr. J. T. Rothrock, botanist of the survey. This lake is situated in the South Park, at an elevation of 9,500 feet above the sea.

No.	Locality.	Date.	Collector.
160	Twin Lakes, Colo.....	July, 1873	Dr. J. T. Rothrock.

CATOSTOMUS DISCOBOLUS, Cope.

Catostomus discobolus, COPE, U. S. Geol. Surv. Wyoming & Contiguous Territories, 1870, 435.—*Id.*, Proc. Am. Phil. Soc. Phila., 1874, 138.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 12.

Numerous specimens from the Zuñi River, New Mexico, and from another locality in Arizona, obtained by H. W. Henshaw and Dr. C. G. Newberry.

No.	Locality.	Date.	Collector.
C C C	Arizona	—, 1873	Dr. C. G. Newberry.
504 X	Zuñi River, N. Mex	June, 1873	H. W. Henshaw.
504	..... do	July, 1873	Do.

CATOSTOMUS FECUNDUS, Cope & Yarrow, *sp. nov.*

PLATE XXXII, FIGS. 1, 1*a*.

At the first examination of this species, it was supposed to be identical with Girard's *Acomus generosus;* but a comparison with his type in the National Museum at the Smithsonian Institution proves it to be a new species. It is a true *Catostomus*, having the parietal fontanelle well marked and widely open. The head enters in entire length 5 times, the diameter of orbit 6 times in greatest length of side of head. The insertion of the dorsal fin anteriorly is nearer the end of the muzzle than insertion of caudal; the ventrals originating below middle of dorsal. The width of the dorsal to ventral enters the entire length to insertion of caudal 6 times.

Radii: D. 12–13; A. 1–8; P. 17; V. 11. Scales, are in 20 longitudinal rows from the insertion of the first dorsal to pectoral, and in 60 transverse rows from branchiæ to insertion of caudal; they are elongate and octagonal, smaller on dorsal region, and larger on ventral. Body elongated, subfusi form. It differs from *C.* (*Acomus*) *generosus*, Gir., in many particulars, as may be seen from the following comparisons:

Girard's species has no fontanelle; is shorter and narrower; the diameter of orbit enters greatest length of side of head 5 times instead of 6. The anterior insertion of dorsal fin is equidistant between the end of the snout and the insertion of the caudal, while in *C. fecundus* it is nearer the end of snout than insertion of caudal. The ventrals in *C. generosus* originate under the posterior third of the dorsal; in *C. fecundus* under the middle third of the dorsal. The radii in *C. generosus* are: D. 10; A. 2–7; P. 16; V. 10; C. 27; in *C. fecundus:* D. 12–13; A. 1–8; P. 17; V. 11.

This species is abundant in Utah Lake, and is called "sucker" by the settlers. They run well up the rivers to spawn in June; feed on the bottom and *eat spawn* of better fish; spawning beds on gravel; bite at hook sometimes; are extremely numerous, and are considered a nuisance by the

fishermen, but they meet with a ready sale in winter at an average price of 2½ cents per pound.

No.	Locality.	Date.	Collector.
508	Utah Lake, Utah	July, 1872	Dr. H. C. Yarrow and H. W. Henshaw.
509	..... do	.... do	Do.
800	..... do	Nov., 1872	Do.
801	..... do	.... do	Do.

CATOSTOMUS GUZMANIENSE, Girard.

Catostomus (Acomus) guzmaniensis, GIR., Proc. Acad. Nat. Sci. Phila., viii, 1856, 173.
Acomus guzmaniensis, GIR., U. S. & Mex. Bound. Surv., ii, pt. ii, 1859, Ichthyology, 39.

We find in the collection a specimen which corresponds with Girard's species known as *Acomus guzmaniensis*, the type of which was procured in the Janos River, a tributary of Lake Guzman, Chihuahua. The specimen under consideration was procured at Lake Utah, Utah, in 1872, and has been overlooked until lately. This species has a fontanelle, and is consequently a true *Catostomus*. It resembles *C. latipinnis*, Gir., but has larger scales, especially on the dorsal region.

No.	Locality.	Date.	Collector.
(?)	Lake Utah, Utah	July, 1872	Dr. H. C. Yarrow and H. W. Henshaw.

MOXOSTOMA, Raf.

MOXOSTOMA TRISIGNATUM, Cope, *sp. nov.*

Represented by numerous specimens from the Upper Arkansas River, none of which are mature. It is therefore possible that in adults the lateral line of tubes may be developed, in which case this species will be referred to the genus *Catostomus*.

The head is rather large, as in other *Moxostomæ*, and is wide above and square. The dorsal outline is very little arched, although the body is not slender. Head 3.4, depth 4 times in length without caudal fin; muzzle not produced; mouth small; lips full, tubercular; scales a little smaller

anteriorly in 19 longitudinal and 64–5 transverse series. Fin radii: D. I. 11–12; A. 7; V. 10; dorsal exactly half way between end of muzzle and basis of caudal fin. Orbit 4.2 times in head; twice in interorbital width.

Color silvery, with steel reflections; upper surface pale-brown with dark-brown scales arranged so as to make imperfect shades across the back. Three black spots on each side, one above the middle of the pectoral fin, one above the origin of the ventral, and one near the base of the caudal. Length, $0^{m}.07$.

The large lateral spots of this species are not seen in any other of the order.

No.	Locality.	Date.	Collector.
1 A	Pueblo, Colo		C. E. Aiken.

PTYCHOSTOMUS, Agass.

PTYCHOSTOMUS CONGESTUS, Gir. (?).

Ptychostomus congestum, Gir. (?), U. S. & Mex. Bound. Surv., ii, 1859, 36, pl. xx, figs. 5–8.

Three fine specimens, referred provisonally to this species, exhibit the following characters: Scales, $\frac{6}{22}\frac{}{5}$. Radii: D. I. 13; A. 7; V. 9. The head enters the length without caudal fin 4.5 times, or 5.5 times into the total. Eye 4.5 times in length, and twice in interorbital width of head. Vertex with low lateral ridges; front perfectly flat. This is one of the short-headed species, intermediate in this and other respects between the *P. erythrurus*, Raf., and *P. aureolus*, Les., of the eastern and Mississippi waters. *P. congestus* is a Texan species, with two more rows of scales than the present individuals, a point of some note in this genus.

No.	Locality.	Date.	Collector.
1270 A	Ash Creek, Ariz	July, 1874	Dr. J. T. Rothrock.

CARPIODES, Raf.

CARPIODES GRAYI, Cope.

Carpiodes grayi, COPE, Proc. Am. Phil. Soc. Phila., 1870, 482.

Scales, $\frac{6}{33}\frac{}{6}$. Radii: D. I. 23; A. 7; V. 9. Head entering length, exclusive of caudal fin, 3.75 times; depth entering the same 2.83 times.

Several specimens; San Ildefonso, N. Mex.; Prof. E. D. Cope.

ORTHODON, Gir.

The species of this genus bear a general resemblance to *Gila*, but the insertion of the fins, particularly the ventrals, is different. In dental peculiarities, it has some affinity with *Hybognathus*.

ORTHODON MICROLEPIDOTUS, Gir.

Gila microlepidota, AYRES, Proc. Cal. Acad. Nat. Sci., i, 1855, 21.
Orthodon microlepidotus, GIR., Proc. Acad. Nat. Sci. Phila., viii, 1856, 182.—BD. & GIR., P. R. R. Rep., x, Ichthyology, 1859, 237.

This species, called "Chub" by the Mormon settlers, is extremely abundant in Utah Lake, and also in the Provo River, running into this beautiful sheet of water. Spawn in May and June, and are terribly destructive to small fish and spawn, eating their own as well as others'. Run up the stream to spawn, depositing their eggs in *muddy* places. Average price five cents per pound. Are considered a fair table fish. Will bite any time at anything, and almost anywhere in Provo River.

No.	Locality.	Date.	Collector.
1872	? Utah Lake, Utah	July, 1872	Dr. H. C. Yarrow and H. W. Henshaw.

NOTE.—Professor Cope declines to be answerable for the locality named, as he considers this fish an exclusively Pacific slope form; we have consequently marked its locality doubtful.

ISOPONDYLI.

COREGONUS, Cuv.

COREGONUS VILLIAMSONII, Gir.

Coregonus williamsonii, GIR., P. R. R. Rep., x, 1859, 326.—*Id.*, Proc. Acad. Nat. Sci. Phila., viii, 1856, 136.

Coregonus villiamsoni, COPE, U. S. Geol Surv. Wyoming, 1870, 433—*Id.*, U. S. Geol. Surv. Montana, 1871, p. 469.—*Id.*, Proc. Am. Phil. Soc. Phila., 1874, 132.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 6

SPECIFIC CHARACTERS.—Head contained five times and a half in the total length. Mouth small; posterior extremity of maxillar bone not extending quite as far as the anterior rim of the orbit. Eye moderate, subcircular; its diameter entering about five times in the length of the side of the head. Anterior margin of dorsal fin nearer the posterior edge of the base of the adipose than the extremity of the snout. Scales well developed, disposed upon eighteen longitudinal series across the line of the greatest depth; nine between the lateral line and the base of the dorsal; and eight between the lateral line and the insertion of the ventrals. Color bluish-lead above, whitish beneath, with a silvery reflect.

Br. VII: VII; D. 2, 12 + 1; A. 2, 12 + 1; C. 5, 1, 9, 8, 1, 6; V. 12; P. 16.

Upon comparison of specimen No. L with Girard's description and type, we find some marked differences, which are here noted. Total length of specimen examined, 17 inches; but we have seen others even longer. Girard mentions 11 inches as the length of his specimen. Head contained nearly 5½ times in the total length. Mouth small; posterior extremity of maxillar bone extending as far as anterior rim of orbit. Eye moderate, subcircular; diameter in alcoholic specimen thirteen twenty-fifths of an inch, entering about six times in the length of the side of the head. Anterior margin of dorsal fin nearer the posterior edge of the base of the adipose than the extremity of the snout. Scales well developed, somewhat larger in dorsal than ventral region, disposed upon 20 longitudinal series across the line of the greatest depth just in front of anterior base of dorsal fin, 10 between the lateral line and insertion of the ventrals, 10 between the lateral line and base

of the dorsal. Colors in life, bluish neutral tint above, silvery-white beneath.

Radii: Br. 8–8; D. 1–12; A. 1–12; C. 5, 1, 9, 8, 16; V. 2–12–12; P. 2–16–16.

The specimens from the Provo River correspond generally with Girard's specimens, but there appears to be an exaggeration in the size of certain parts, notably the adipose fin, and maxillary bone; in short, the whole physiognomy of our specimens differs in being much larger. This appearance may, perhaps, be due to the fact that Girard's specimens were very old, and have contracted greatly during their twenty years' preservation in alcohol; ours are comparatively fresh.

This fish, belonging to the Puget's Sound fauna, we in vain endeavored to find at Provo, in July, 1872, and it was not until November that we succeeded in procuring specimens. At this time, many were being taken with *hook* and *line*, and we were informed it is seldom taken in any other way. Occasional stragglers find their way to the lake, and are then taken with trout, but this seldom occurs. They go far up the mountain streams to spawn, but the time could not be ascertained. It is probably early in summer, as no fish were heard of below Provo Cañon in July. They are frequently taken eighteen inches in length. The average price is twenty cents per pound, and they are highly esteemed for the table. This fish is also found high upon the Sevier to the southward, but is by no means so numerous as in the Provo River.

No.	Locality.	Date.	Collector.
L	Provo River, Utah	Nov., 1872	Dr. H. C. Yarrow.
L 1	do	do	Do.
D 13	Sevier River, Utah	Aug, 1872	Do.

SALMO, Linn.

Of this genus, quite a number of species are found in the lakes and streams of the Rocky Mountains, and are very nearly allied: *Salmo virginalis* being the characteristic fish of the lakes of Utah; *S. pleuriticus* of Ne-

vada, Montana, and Colorado; and *S. spilurus* of Western Colorado and New Mexico. These all belong to the group *Salar*.

The following brief synopsis of the *Salmonidæ* of the regions under discussion may prove useful for purposes of identification:

Depth 5.75 in length; eye 4.5 times in head; snout obtuse; caudal fin scarcely emarginate; Br. IX.....*S. virginalis.*

Depth 4.75 in total (to point of caudal); eye 5 times in head; muzzle acute; scales larger, 26 below dorsal fin; cranium not keeled above; head one-fourth length; dorsal fin nearer muzzle than end of caudal scales; caudal fin scarcely emarginate; Br. X.....*S. spilurus.*

Head large, broad, flat, not keeled, 4.25 in total, equal depth of body; muzzle obtuse; eye nearly 5 times in head; scales 42 below first dorsal ray; dorsal fin equidistant; caudal fin not notched.....*S. stomias.*

Head smaller, 4 times in length to notch of caudal (which is well emarginate); upper surface keeled; muzzle obtuse; eye 4 times in length; depth 4.5 in length to end of caudal scales; dorsal midway between latter and end of muzzle; scales small, 40–43 below dorsal first ray; Br. XI.....*S. pleuriticus.*

Head acuminate, keeled above 4.66 times in length to notch of caudal fin, which is well marked; eye 0.2 of head; depth 5.25 to caudal notch; dorsal nearer muzzle than end of caudal scales; scales large, 33 below dorsal first ray; spots large, distinct; Br. XII.....*S. carinatus.*

Head $\frac{1}{4}$ total length; eye 5 times in head; dorsal fin equidistant between insertion of caudal and end of muzzle; muzzle rather pointed; Br. X–XI.....*S. irideus.*

S. spilurus and *S. carinatus*, of those above enumerated, are readily distinguishable by their smaller orbits and large scales; as in *S. stomias* and *S. pleuriticus* the scales are quite small in comparison. But it should be mentioned that *S. carinatus* and *S. pleuriticus* resemble each other in the presence of the strong median carina on the superior aspect of the cranium. *S. stomias* may be readily known by the large mouth and head. Its habitat, as far as known, is the Kansas River, far to the eastward of the Rocky Mountains.

SALMO VIRGINALIS, Gir.

Salar virginalis, GIR., P. R. R. Rep., 1859, Ichthyology, x, 320, pl. lxiii, figs. 1–4.—*Id.*, Proc. Acad. Nat. Sci. Phila., viii, 1856, 220.

Salmo virginalis, COPE, U. S. Geol. Surv. Wyoming, 1870, 433.—*Id.*, U. S. Geol. Surv. Montana, 1871, p. 469.—*Id.*, Proc. Am. Phil. Soc. Phila., 1874, p. 130.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 6.

Description according to Girard.

SPECIFIC CHARACTERS.—Body subfusiform in profile, otherwise compressed; head comprised about four times in the total length; the caudal fin excluded; jaws subequal; posterior extremity of maxillary extending to a vertical line, intersecting the posterior rim of the orbit. Anterior margin of dorsal nearer the extremity of the snout than the insertion of the caudal fin. Grayish-brown, with a purplish reflection and subcircular black spots; beneath olivaceous, unicolor.

Br. 9:9; D. 12:0; A. 11; C. 7, 1, 9, 8, 1, 8; V. 8; P. 14.

A comparison of specimens in the collection of the survey gives the following result:

Length of two specimens 14½ and 15.2 inches. Head enters total length, caudal fin included, about four and one-third times. Posterior extremity of maxillary extends to and intersects a vertical line drawn one-fifth of an inch in rear of posterior rim of orbit; anterior margin of dorsal nearer insertion of caudal than snout. Eye large, subcircular, entering 8–7 times in greatest length of side of head, and over twice in advance of anterior rim of orbit. Caudal five and two-thirds in total length. Line vertical drawn from insertion of ventral reaches the sixth spine of dorsal; 36–36 rows of scales above lateral line, 40–41 below. Br. 11–11; D. 12; A. 12; C. 7–1–9–8–1–8; V. 9–9; P. 14–14. The characters here given we find are constant in a number of specimens, and it may be noticed some grave differences exist between our own and Girard's specific characters. His general description of the species is good, however, and leaves little to be desired. It may be mentioned that the dark spots which are found on the dorsal aspect of this species frequently run into the conjunctiva of the eye; this fact as far as known has not been observed in other species.

By an extended examination of specimens, we are ready to state that this species certainly maintains its distinctness from *S. pleuriticus*, Cope, from the streams which flow from the mountains on both sides, in its more slender form of head and body. The depth enters the length 5.75 and 6 times, and equals the length of the head to the preoperculum. In *S. pleuriticus* of equal size, it enters the length 4.66 times, and nearly equals the length of the head

As this fish possesses interest from an economic point of view, the following account, compiled from Dr. H. C. Yarrow's field notes, may be found of interest:

The Lake Trout, or, as it is sometimes called, the Brook and Speckled Trout, by the inhabitants of Utah, is one of the most characteristic and numerous fish of the Territory, affording a valuable, healthy, and cheap article of diet. This fish has existed for years in immense numbers, and for this reason it is rather singular that its occurrence was not noticed until the party of this survey visited Lake Utah in 1872. This fish is found in Utah and Panquitch Lakes (the latter in Southern Utah) throughout the year, being most abundant during July and August, at which time these notes were hastily taken.

In comparison with the other fishes of Utah, the Lake Trout is undoubtedly the most numerous and the most easily captured; how long, however, this condition of affairs will last it is impossible to say, the supply having greatly diminished during the past few years, owing to the reckless methods of fishing and increase in the number of fishermen; moreover, a larger demand is now made for this fish, owing to increase in the number of settlers. The decrease in the yield may be roughly estimated at about one-third, but this percentage is slowly but surely increasing. The greatest size this fish attains, as far as could be learned on inquiry and from personal observation, is three feet; weight about fifteen and a half pounds. The average length, however, is about fourteen inches, and average weight one and a half pounds. The rate of growth is not known, although it is stated by the fishermen to be perhaps an inch per annum, but according to my belief the rate is greater. The fish is supposed to attain its full size in about five years. In shape there is very little difference between the male and female; though near the breeding season the female is the larger and more brilliant in color.

This increased brilliancy of color affects both sexes, but is noticeable in a more marked degree in the female. About breeding time, the eyes are brighter, scales more brilliant, and the superficial blood vessels more fully engorged than ordinarily; the movements are more rapid, a celerity being displayed quite at variance with its usual somewhat sluggish habits. This fish winters in the deepest waters of the lakes, as most of the mountain streams to which it resorts in spring and summer are shallow and very cold. The male and female, large and small, run indiscriminately together; the presence of this fish in any particular locality being indicated by the presence of flocks of birds hovering over the water. Except in the month of July, when unusually sluggish, the Lake Trout may be taken at any time with the hook and line, and, being high spirited and particularly gamy, affords excellent sport for the angler. In summer, it swims low in the water, in order, it is thought, to avoid the extreme heat of the sun. In winter, it prefers the deepest water.

As far as could be ascertained, the spawn has not been observed to run from this fish when captured, either by the line or net, for the reason, most likely, that the gravid female is seldom taken just prior to or during the time of spawning. It first enters the mouths of mountain streams and rivers to spawn about the middle of March, remaining until the middle of May, by which time the majority have fulfilled their reproductive functions. It is at such times that the fishermen, lying in wait at the mouths of the rivers, are able to capture such enormous quantities. In coming on to the breeding grounds, all sizes are found together, young and old, little and big. The favorite localities for feeding in summer are close to the mouths of rivers, the water of which from the mountains is ice cold, from ten to twelve feet deep, and the current very swift. As already stated, the cold water is preferred in summer and warm in winter.

After spawning, the trout invariably swim in schools, from one part of the lake to the other, in search of food; a solitary fish at such time being seldom seen. In traveling, the trout is nearly always accompanied by its friendly companions, the mullet, sucker, &c., which share with it the danger of attack by man and birds.

Notwithstanding the apparent affection existing between the different

species of fish in Lake Utah, the trout does not hesitate to prey to a large extent upon the young of other kinds, suffering itself, in return, in the same way, but in a much less degree. The trout is very voracious, devouring other fish smaller than itself, particularly a species locally known as "Silver-sides" or "Leather-sided Minnows" (*Gila* (*Clinostomus*) *tænia*, Cope, *sp. nov.*), of from two to six inches in length; on dissection, I found the stomach of the trout crammed with these little fish. Grasshoppers, too, are a source of diet to the trout, with flies and other insects, while they do not disdain even snakes and frogs of tolerably large size. With regard to the methods of feeding, I have not been able to perceive or otherwise learn of any peculiarities of the trout unless it be the great eagerness with which they seek their food and the rapidity of devouring the same, especially with reference to bait on the hook. The quantity of food it consumes, judging from personal observations and accounts of experienced fishermen, must be enormous. During the spawning season, no very observable changes take place in the trout except those mentioned above, and also that the under part of the cheek of the female becomes very bright. As a rule, it may be stated that in general appearance the male is much less bright than the female at this season, and smaller.

Before spawning, the nests are made in the sand or gravel by a rotary motion of the tail of the male. Into this cavity, the eggs are exuded by the female, which is sedulously guarded by the male until the process is completed, when the latter deposits the milt which is to impregnate the eggs. No further care is taken by either after the deposition of the impregnating substance. Most of the spawning is done in the rivers, but the process takes place in the lake also to some extent. Spawning is greatly interfered with by the nets used by fishermen; knowing the time when fish begin to run up the rivers, the nets are drawn near the mouth of the streams, and large numbers of fish taken. It is not known at what age this fish begins to breed, nor what period of time the process continues, although both these points might be definitely ascertained by careful observation of captives under favorable circumstances. The act of spawning exerts an injurious effect on the flesh of the fish, rendering it poor and insipid. In addition, many of the fish seeking the upper parts of the rivers, to fulfill their repro-

ductive duties, do not survive the severe bruises and other injuries they meet with in their journey past the rocks and through the rapid currents of the mountain streams.

The water in the locality in which the trout spawns has never been noticed to be whitened by the milt, but it does present a translucent pinkish appearance after the event.

The temperature of water most favorable for hatching appears to be the coldest obtainable; the eggs, in many cases, being laid directly on the bottom of ice-cold mountain springs. The color of the spawn is whitish pink; each egg, just previous to spawning, being the size of No. 4 shot. In July, the eggs are not larger than No. 12, or dust shot. The eggs, when spawned, always sink to the bottom, where they remain unless eaten or carried away by the swift current. As already stated, the nest is made from gravel and stones entirely; no other materials being used as far as has been observed. The eggs are hatched in March, April, and May, but the number of days required by the process is not known. The spawn and young fish suffer greatly from the attacks of other fish, aquatic reptiles, and even from the large fish of their own species; these seeming to have no affection for their young. It is rather a singular fact that the very young trout is seldom seen or taken either by hook or net, and I am unable to account for the same unless it is that it resorts to unknown localities until a larger growth is obtained. Its food, so far as known, consists principally of small insects.

No steps have as yet been taken to increase the supply of this valuable fish by artificial means, the yield still being large enough to meet the wants of the settlers and miners; but, in the course of a few years, artificial propagation must be resorted to, for although certain laws have been passed regulating the size of the meshes of nets, no attention is paid to them by some greedy individuals, who think only of filling their own pockets at the expense of future generations. It may be mentioned in this connection that a letter, prepared at the request of the Hon. G. Q. Cannon, and bearing on this subject, has been presented to the legislature of Utah. It suggests the enacting of certain laws with reference to the preservation of fish, &c., and that the same be rigidly enforced when passed.

No epidemic causing sickness or destruction of life among the trout of Utah and Panquitch Lakes has ever been known, nor is this fish ever affected with parasites, as are many of the marine species. I must state, however, that I have been informed by a trustworthy friend that the same fish of the lakes in the Yellowstone region is uneatable in the summer; its flesh being riddled and filled with parasitic tape worms of considerable size, many, according to Dr. Leidy, being *five inches* in length. Mr. Carrington, whose notes accompanied the specimens examined by Dr. Leidy, states that the smaller worms were contained in cysts adherent to the exterior of the intestines, while the larger ones, up to six inches in length, were found imbedded in the flesh. From five to fifty of the parasites were found in a single fish. When numerous, they appeared to affect the health of their host, and the fishes most infested could generally be told by their duller color, meagerness, and less activity. Dr. Leidy states that this worm belongs to the genus *Bothriocephalus*, or rather to that section of it now named *Dibothrium*. Two species have long been known as parasites of the salmon and other members of the same genus of fishes in Europe; but the tape worm of the Yellowstone trout appears to be a different one, and may, from the shape of its head, be named with propriety *Dibothrium cordiceps*.

The trout of Utah Lake may be taken at nearly all seasons by both hook and net at all times, but in Panquitch Lake by hook only, since fishing in any other way is prohibited by common consent. This, however, is no hardship, since large captures are easily made with the hook, I myself having taken from thirty to forty pounds' weight in a single hour's fishing. The hooks used are simply large steel ones, with a snood, or snell, of piano wire, which is strong and flexible. The best bait is minnow and grasshopper, although this trout will bite at almost anything. In Panquitch Lake, a fish's eye is considered a very tempting bait. The nets used in Utah Lake are made of Nos. 9, 12, and 18 cotton twine, are generally four hundred yards long, 8 to 10 feet deep, and are furnished with brails at each end; when employed, they are reeled into the boats by means of a wooden windlass in the stern. The average daily catch of one person with hook and line would perhaps be twenty pounds, or about thirty-six hundred pounds

the entire season; for a net of the dimensions above specified, one hundred and fifty pounds daily in summer and thirty or forty in winter.

This trout is highly prized by the settlers and miners of Utah, and quite a large proportion of those taken are consumed in the immediate neighborhood; the remainder being sent to the different mining camps, settlements, and the Salt Lake City market. As an article of food, its excellence is not surpassed by any fish, either fresh or salted, the delicacy and firmness of its flesh commending it to all who have a preference for fish diet. Furthermore, it retains for a longer period than most fish its unequaled and unique flavor. All that are captured are readily disposed of, mostly in a fresh state, though a few are salted and smoked. In no case is it used for manure, nor is it ever exported. The retail price of the fish in its fresh state varies from twenty to thirty cents per pound; wholesale from ten to fifteen cents; salted ones bring from ten to fifteen cents. These prices are about those formerly obtained and are now current in the Salt Lake market.

In September and October, the trout are somewhat scattering, and do not approach the shore; consequently large hauls are seldom made at this period.

Mr. Madsen states it as his opinion that the female in spawning ejects only a portion of her eggs, as he has found on dissecting the trout after the spawning season eggs of various sizes, some very small and others full grown. The manner of seine fishing in the locality mentioned is quite similar to that pursued in the East, excepting that two boats are used instead of one; the seine being paid out from one of the boats, which generally takes position to the southward of Provo River, while the other, with a line attached, makes a semicircle. As there is a perceptible current setting from the southern arm of the lake, increased by the southwest wind, the net is gradually drifted to near the mouth of the river; the boats then approach each other, the brails are seized, and the lead line is held down by the feet of the fishermen, who jump into the shallow water into which the net is drawn; the fish being secured as the net is gradually hauled in. In winter, fishing is carried on under the ice, holes being cut at certain distances, and the net introduced by means of spars; it is then dragged to a favorable open space and the fish collected. The hauls in winter, however, scarcely

repay the labor bestowed; the net is sometimes seriously damaged, and the trout are shy and run into deep water; but the so-called suckers are very numerous, and meet with a ready sale.

The foregoing observations, as already stated, are the result of notes taken in Utah in July, 1872, by myself and assistant, Mr. Henshaw, though in some instances valuable aid and information were obtained from Mr. Peter Madsen, an intelligent Danish fisherman of Utah Lake, who kindly placed at our disposal data obtained during many years' experience acquired in this locality.

In conclusion, it may be stated that the Utah Lake trout is of vast economic importance to the settlers of the Great Salt Lake Valley, supplying as it does a comparatively cheap and most excellent article of sustenance, and one to the preservation of which special attention should be speedily given, since, if means are not shortly taken to prevent the destructive methods of fishing now employed, the species must become extinct after a few years. A number of fishermen, having no fear of the law, which is virtually a dead letter, are in the habit of visiting Utah Lake from Salt Lake City and other localities, and make use of nets of very small mesh for the express purpose of taking in small fish, which readily sell for ten cents per pound in the Salt Lake market. As already mentioned, this reckless and destructive mode of fishing is in no wise tolerated by the people of Panquitch, nor should it be by the residents of Provo City, near Utah Lake. Mr. Madsen, who lives on the lake, and who has been engaged in fishing for the past eighteen years, complains bitterly of these interlopers and law breakers, as he finds his profits are gradually decreasing with the number of fish from year to year. He mentions that, in 1864, such was the abundance of this fish, that in one haul of the seine, discarding all other kinds, he secured between thirty-five and thirty-seven hundred weight of trout, while at the present time five hundred pounds is considered an enormous haul.

No.	Locality.	Date.	Collector.
80 X	Provo, Utah	Aug., 1872	Dr. H. C. Yarrow.
88 X 8	Panquitch Lake, Utah	Sept., 1872	Do.

Of these specimens eight or ten individuals are from Provo; six or eight from Panquitch.

SALMO SPILURUS, Cope.

Salmo spilurus, COPE, U. S. Geol. Surv. Montana, &c., 1871, 470.

This fish was only observed in the Brazos River, one of the principal head tributaries of the Chama. Twenty-three specimens were examined, which all agree in possessing larger scales, a lighter color, and a larger size than the *S. pleuriticus*, which lives in the same region. This trout is the finest game and food fish of New Mexico, as the members of our party had good opportunity of ascertaining. It has so far only been found in the head-waters of the Rio Grande, near the mountain ranges, and perhaps may prove to be a large and well marked race of the more widely distributed *S. pleuriticus*. On six specimens, the following numbers of scales were counted above and below the lateral line: (1) $\frac{33}{35}$; (2) $\frac{33}{37}$; (3) $\frac{34}{37}$; (4) $\frac{37}{39}$; (5) $\frac{34}{37}$; (6) $\frac{34}{38}$. The cranium is not keeled on the middle line. The color is a very light yellowish-brown, marked with small spots, which are composed of decussating lines. There are but few of them in advance of the anal fins, and none (except in one) in front of the ventrals. A red band on each side of the chin.

SALMO PLEURITICUS, Cope.

Salmo pleuriticus, COPE, U. S. Geol. Surv. Wyoming, 1870, 433.—*Id.*, U. S. Geol. Surv. Montana, 1871, 471.—*Id.*, Proc. Am. Phil. Soc. Phila., 1874, 132.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 6.

DESCRIPTION.—A stout species with obtusely descending muzzle; large subcircular eye, which enters head four times. Cranial keel well marked, its elevation being greater between orbits than on posterior part of frontal bones. Interorbital width 1.33 times long diameter of the interpalpebral opening of the eye. Dorsal fin nearer the origin of the marginal rays of the caudal than to the end of the muzzle, but is midway between the latter and the termination of the scales on the sides of the fins.

Radii: Br. XI; D. 2, 11–12 and 13; A. II. 11. Scales from 40 to 45 below first dorsal ray to lateral line. Maxillary bone extends a little beyond posterior rim of orbit; is not expanded. This species is well spotted,

the typical specimen especially, and the spots are found mostly above the lateral line on the entire caudal peduncle, dorsal and caudal fins, are rather scattered, less numerous on peduncle than *S. spilurus*. Sides with short, broad, longitudinal bars of crimson, and a band of the same color occupies the fissure within each ramus of the mandible and skin on the median side of it. The fins are all more or less crimsoned; none black-bordered. Color bluish silvery-lead color on back, yellowish-white beneath. Largest specimen 21½ inches. We have in our collection a fine series of this species and of its varieties. The typical is represented by a number, and after a careful examination of the remaining ones we are obliged to note some differences which may entitle them to be considered subspecies or varieties.

Of the lot marked 204 B, from the Rio Grande, we have examined nine specimens, and find them typical in all respects.

Lot No. A, from Rio Grande, Colorado, which may be called var. *a*, or large spotted variety, contains two specimens. In these we find that the spots are quite large, round, but somewhat isolated and infrequent; greatest number on tail; none on the head. The posterior extremity of maxillary bone is on a line with the posterior rim of the orbit.

Lot No. 596 from White River, Arizona, containing three specimens, may be called var. *b*, or large and small spotted variety. Spots large and small, larger and more frequent on dorsal region and head; maxillary extending beyond rim of orbit.

Lot No. 205 A, two specimens, from Rio Grande, Colorado, have very small and partially semicircular spots, the concentration of which is near the caudal region; few on cheeks; none on top of head. Eye 5½ times in greatest length of side of head. Head 4.50 of total length, including caudal. Dorsal midway between insertion of caudal and end of snout. Scales, 37–40, below dorsal first ray to lateral stripe, 43–45 below. Maxillary extends seven twenty-fifths of an inch behind posterior rim of orbit.

Radii: Br. XI:XI; D. 12–12; A. 11–11. The scales in these specimens are as large nearly as *S. spilurus*.

No.	Locality.	Date.	Collector.
370	Fort Garland, Colo	June, 1873	H. W. Henshaw.
61	White Mountains, Ariz	Aug., 1873	Do.
596	....do	.... do	Do.
A	Rio Grande, Colo	Oct., 1873	Dr. J. T. Rothrock.
205	....do	.... do	Do.
205 A	....do	.... do	Lieut. W. L. Marshall.
204 B	....do	.... do	Dr. J. T. Rothrock.
4 B	?	——, 1873	?
81	Fort Garland, Colo	July, 1874	W. G. Shedd and C. E. Aiken.
140	....do	Aug., 1874	Do.
126 B	Costilla, N. Mex	.... do	Prof. E. D. Cope.
128	Rio Taos, N. Mex	.... do	W. G. Shedd.
227 A	Chama River, N. Mex	.... do	Do.
?	Near San Ildefonso, N. Mex	.... do	Dr. H. C. Yarrow.
268	Pagosa, Colo	Sept., 1874	C. E. Aiken.
354	....do	.... do	Do.
355	....do	.... do	Do.
357	....do	.... do	Do.
358	....do	.... do	Do.

HAPLOMI.

GIRARDINUS, Poey.

GIRARDINUS SONORIENSIS, Gir.

Girardinus sonoriensis, GIR., Proc. Acad. Nat. Sci. Phila., 1859, 120.

Numerous specimens; Camp Lowell, Ariz.; H. W. Henshaw.

FUNDULUS, (Cuv.) Val.

FUNDULUS ?MULTIFASCIATUS, (Cuv.) Val.

One specimen; Arkansas River, at Pueblo, Colo.; Mr. C. C. Aiken.

HAPLOCHILUS, Günther.

HAPLOCHILUS FLORIPINNIS, Cope.

PLATE XXVIII, FIGS. 4, 4*a*, 4*b*.

Haplochilus floripinnis, COPE, Proc. Am. Phil. Soc. Phila., 1874, 138.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 12.

First dorsal ray standing above the second or third anal. Formula: D. 10–11; A. 13–14; V. 7. Scales large, in 10 longitudinal and 29 trans-

verse series. First dorsal ray half as far from base of caudal as from end of muzzle. Length of head 4.66 times in total, a little less than four times to basis of caudal fin. Orbit large, 3.2 times in length of head and 1.6 times in interorbital width. Mandible projecting a little beyond premaxillary; one external series of teeth in both jaws larger than the others.

Total length, 0m.0595; length to anal fin, 0m.0335; length to basis of ventral fin, 0m.027; length of head, 0m.0138; width of head at pterotics, 0m.008. Color olive-gray; the scales with ocher borders; fins yellow, broadly edged with crimson.

Numerous specimens from the Platte River, near Denver, Colo. No. 65 a species with large scales.

The plate affords views of this fish from the side, and the upper and lower aspects of the head.

No.	Locality.	Date.	Collector.
66 C	Cherry Creek, Arkansas River, Colo	May 11, 1873	H. W. Henshaw.
65	Denver, Colo	May 12, 1873	J. M. Keasbey.
65 A B	do	do	Do.

PERCOMORPHI.

URANIDEA, De Kay.

URANIDEA VHEELERI, Cope.

PLATE XXXII, FIGS. 3, 3*a*, 3*b*.

Uranidea wheeleri, COPE, Proc. Am. Phil. Soc. Phila., 1874, 138.—*Id.*, Rep. Plagop. & Ichthy. Utah, 1874, 12.

The only Physoclystous or spinous-rayed fish as yet found in the Great Basin of Utah.

Radial formula: Br. VI; D. VII. 17; A. 12; P. 15, all simple. The head is depressed and enters the length minus the caudal fin three times. Orbit large, one-fifth length of head and twice the width of the frontal interspace. Greatest depth (at first anal ray) 6.75 times in length, less caudal fin. Anal commencing opposite the third ray of the second dorsal. Lateral line deflexed opposite last ray of second dorsal. The recurved pre-

opercular spine strong; the decurved small and obtuse. Palatine teeth present; end of maxillary reaching line of pupil. Isthmus as wide as length of muzzle and orbit to front line of pupil. Skin everywhere smooth.

Total length, 0m.084; length less caudal fin, 0m.069; length to anal, 0m.042; length to first dorsal, 0m.031; length of head, 0m.022; width at maxillaries distally, 0m.0125; at preopercular spines, 0m.0185.

From Beaver River, Southwestern Utah, and from Rio San Juan Pagosa, Colo. The other species of the Rocky Mountains (*U. punctulata*, Gill) has, according to that zoölogist, a much wider head, especially in the frontal region. This character is well exhibited by specimens in other collections.

Found tolerably abundant in pools left near the river after the spring floods had ceased; living under stones; movements very sluggish.

Dedicated to Lieut. G. M. Wheeler, in charge of explorations west of the one hundredth meridian.

No.	Locality.	Date.	Collector.
282	Pool, near Beaver River, Utah	Sept., 1872	Dr. H. C. Yarrow and H. W. Henshaw.
283	..... do	.... do	Do.
272	Pagosa, Colo	Sept., 1874	Dr. H. C. Yarrow and C. E. Aiken.

It may be mentioned, in addition to the species enumerated from Provo River and Utah Lake, we were informed of the occasional taking of a small fish called "Mountain Mullet", the description of which does not appear to apply to any of those already known from this locality. We were also informed that a small species called "Bullhead" is found under stones in the river bed, the colors of which are gray, spotted with black, having a very large head, with green eyes and very spiny fins; no scales. This is doubtless a cottoid, and it is much to be regretted no specimens were procured.

RECAPITULATION OF THE SPECIES.

The preceding investigation of the Ichthyology of the Southwestern Territories is sufficiently complete to throw much light on questions of geographical distribution. We therefore append lists of the ichthyic faunæ of the distinct water sheds and basins embraced within its scope. These are

(1) the drainage of the Arkansas; (2) that of the Rio Grande; (3) that of the Colorado; and (4) that of the basin Salt Lake.

The species of the Arkansas basin are as follows:—

Amiurus nebulosus, Lesueur.
Rhinichthys maxillosus, Cope.
Ceratichthys physignathus, Cope.
Pogonichthys communis, Gir.
Hypsilepis jugalis, Cope.
Hybopsis scylla, var., Cope.
Hybognathus nigellus, Cope.
Campostoma aikenii, Cope.
Pantosteus virescens, Cope.
Moxostoma trisignatum, Cope.
Salmo pleuriticus, Cope.
Fundulus multifasciatus, Cuv. Val.

The species of the Rio Grande are the following:—

Scaphirhynchops platyrhynchus, Raf.
Lepidosteus, sp.
Anguilla tyrannus, Gir.
Rhinichthys maxillosus, Cope.
Apocope vulnerata, Cope.
Apocope ventricosa, Cope.
Ceratichthys sterletus, Cope.
Gila egregia, Gir.
Gila pandora, Cope.
Gila gula, Cope.
Alburnellus simus, Cope.
Alburnellus jemezanus, Cope.
Hypsilepis iris, Cope.
Hyborhynchus nuchalis, Agass.
Pantosteus jarrovii, Cope.
Carpiodes grayi, Cope.
Salmo spilurus, Cope.
Salmo pleuriticus, Cope.

The most extended list is that of the Colorado basin:—

Plagopterus argentissimus, Cope.
Meda fulgida, Gir.
Lepidomeda vittata, Cope.
Lepidomeda jarrovii, Cope.
Ceratichthys squamilentus, Cope.
Apocope ventricosa, Cope.
Apocope couesii, Yarrow.
Apocope oscula, Gir.
Gila egregia, Gir.
Gila nigra, Cope.
Gila nacrea, Cope.
Gila elegans, Bd. & Gir.
Gila grahamii, Bd. & Gir.
Gila emorii, Bd. & Gir.
Gila seminuda, Cope & Yarrow.
Gila gracilis, Bd. & Gir.
Gila robusta, Bd. & Gir.
Hyborhynchus siderius, Cope.
Pantosteus bardus, Cope.
Pantosteus delphinus, Cope.
Catostomus discobolus, Cope.
Catostomus insigne, Gir.
Ptychostomus congestus, Gir.
Salmo pleuriticus, Cope.
Coregonus villiamsonii, Gir.
Girardinus sonoriensis, Gir.
Uranidea vheelerii, Cope.

The following species are those of the basin of Utah, whether from tributaries of the Great Salt Lake or not:—

Apocope henshavii, Cope.
Apocope vulnerata, Cope.
Apocope carringtonii, Cope.
Ceratichthys biguttatus, Kirt.
Gila egregia, Gir.
Gila hydrophlox, Cope.
Gila montana, Cope.
Gila tænia, Cope.
Gila phlegethontis, Cope.
Siboma atraria, Gir.
Myloleucus pulverulentus, Cope.
Myloleucus parovanus, Cope.
Hybopsis timpanogensis, Cope.
Hybopsis bivittatus, Cope.
Pantosteus platyrhynchus, Cope.
Pantosteus jarrovii, Cope.
Catostomus fecundus, Cope & Yarrow.
Coregonus villiamsonii, Gir.
Salmo pleuriticus, Cope.
Salmo virginalis, Gir.
Uranidea vheelerii, Cope.
Uranidea punctulata, Gill.

APPENDIX.

DESCRIPTION OF A MUGILOID FISH FROM THE MESOZOIC STRATA OF COLORADO.

SYLLAEMUS, Cope.

Allied to the *Mugilidæ*.—A short, spinous, dorsal fin; ventral fins abdominal, posterior to the spinous dorsal. Pectoral fins subinferior in position. Coracoid bones forming a compressed, keeled body. Scales large, cycloid; lateral line present, extending along the middle of the sides. Parietal bones less than epiotics, entirely separated by the supraoccipital. Frontal bones large, wide; their common suture distinct.

The opercular apparatus extends obliquely backward, while the mandible is produced forward; hence the inferior part of the hyomandibular and the symplectic are directed obliquely forward. The end of the muzzle is broken off, but the posterior part of the dentary bone does not exhibit any teeth. The opercular bones are thin, and their inferior borders reach the median line of the inferior side of the head.

The only species of this genus which has fallen under my observation is represented by a specimen in which the body posterior to the femoral bones is wanting. The surface is covered with scales, so that only the outlines of the femoral bones can be distinctly seen. These are thickened and curved outward; those of opposite sides are well separated from each other. The scales exhibit a very delicate concentric line sculpture.

The very posterior position of the ventral fins distinguishes this genus from *Mugil*, while the inferior position of the pectoral fins is not seen in *Atherina*. The lateral line does not occupy the inferior position seen in the

Scombresocidæ. As compared with *Apsopelix*, Cope, from the Benton group of Kansas, *Syllæmus* differs in the absence of dorsal radii or interneural spines anterior to the line the ventral fins. There is doubtless some affinity between the two genera, as the other characters are quite similar. I was unable to detect a lateral line in *Apsopelix*. It is possible that a catalogue name of Agassiz, viz, *Calamopleurus* (Poiss. Foss., v, 122), refers to this or some allied genus, but I am unable to discover that it has ever been described.

SYLLAEMUS LATIFRONS, Cope.

Represented by the entire head and body of a fish as far as the basis of the ventral fins, excepting the end of the muzzle. The scales are completely preserved, while only the bases of the fins remain.

The body is subcylindric, while the head is broad and flat above. The inferior side of the head is contracted, the coracoids forming a keel, and the lower borders of the dentary bones being in contact. The angular portion of the dentary is strongly grooved on its inferior surface, and the proximal or anterior parts of the operculum display a radiate sculpture. The top of the head is smooth, excepting a slight radiate sculpture of the parietals. The outline of the parietals is subround and a little more extended than that of the supraoccipital, which is a short longitudinal oval.

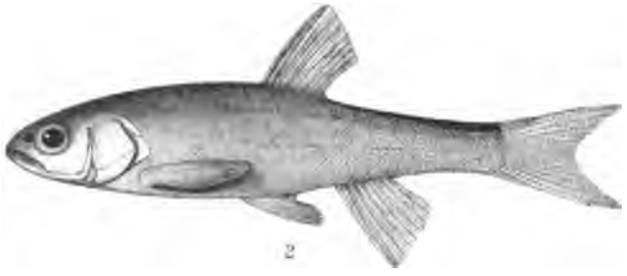
There are twenty-six or twenty-seven longitudinal rows of scales, those of the abdomen not differing from those of the sides. The lateral line runs along the eighth below the dorsal fin, originating just above the base of the pectoral fin. There are nine rows of scales between the occiput and the first dorsal ray. I count the bases of fifteen dorsal radii, which are all fissured anteriorly, excepting the first, which is rudimental. The anterior rays are stouter than the posterior, and they embrace the posterior part of the ray in front of them by the basal fissure. The posterior rays are much narrowed and embrace but little. The pectoral rays are numerous. The physiognomy of this fish is rendered peculiar by the depressed form of the snout, with the narrow under jaw. It is impossible to be sure whether the muzzle was elongate or not.

Measurements.

	M.
Length of specimen to base of ventral fin	0.205
Length of specimen to base of dorsal fin	0.090
Length of specimen to base of pectoral fin	0.075
Length of specimen to edge of operculum	0.071
Length of specimen to edge of preoperculum	0.055
Length of specimen to condyle of quadrate	0.029
Length of specimen to orbit	0.017
Diameter of front between orbits	0.020
Diameter of body at middle of dorsal fin	0.045
Depth of body at middle of dorsal fin	0.050

The specimen which represents this fish in the collections of the survey west of the one hundredth meridian was secured by Lieut. W. L. Marshall, of the expedition, and is said to be from near the summit of Pike's Peak, as he informs us. This locality is not its proper horizon, but the matrix which includes it is that of the Cretaceous or Jurassic beds exposed at the eastern base of that mountain. From these it was doubtless procured and carried to the locality where it was discovered.

1



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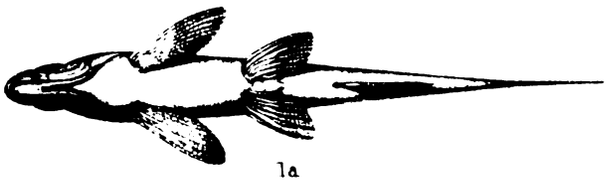

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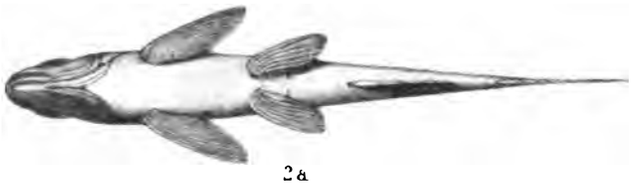

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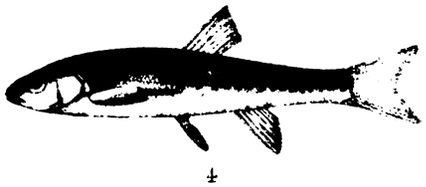

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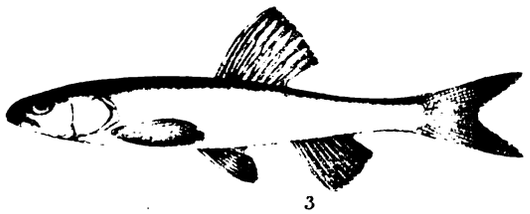

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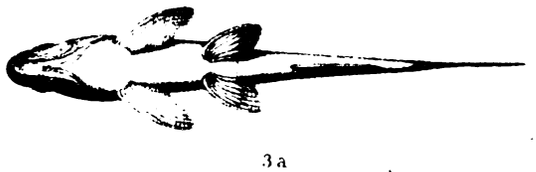
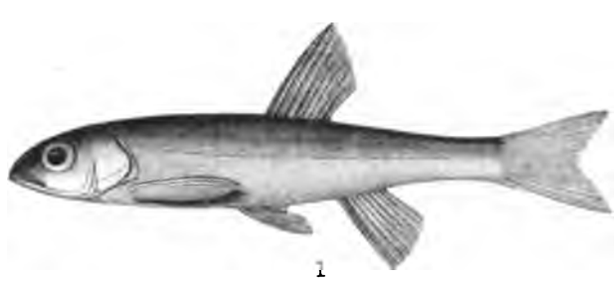


3a

FIG.1 and 1a LEPIDOMEDA JARROVII. FIG.2 and 2a LEPIDOMEDA VITTATA.
FIG.3 and 3a. PLAGOPTERUS ARGENTISSIMUS. FIG.4 and 4a APOGOPE VULNERATA.



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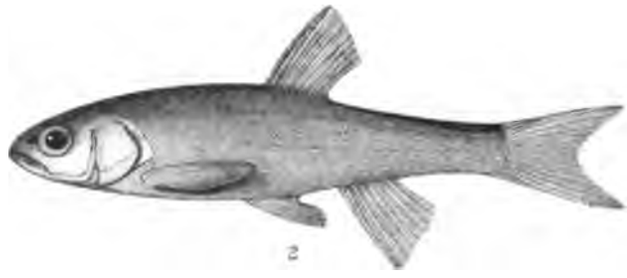

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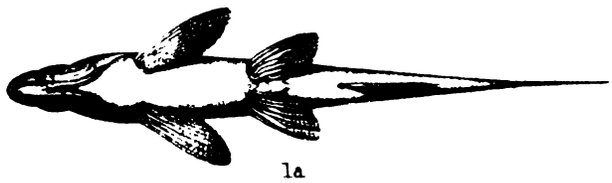

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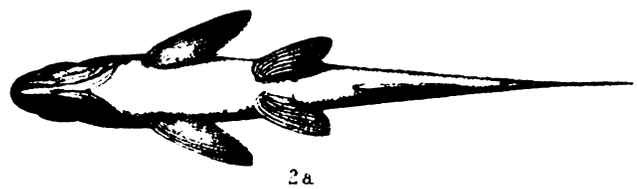

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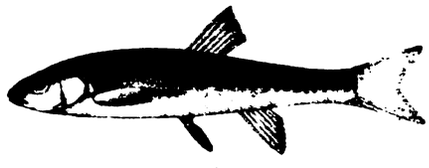

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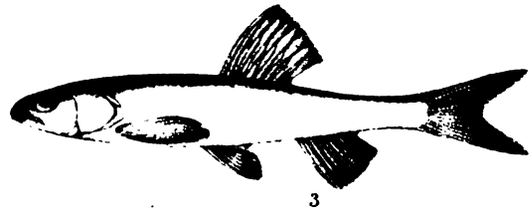

3

4a

3a

FIG 1 and 1a LEPIDOMEDA JARROVII FIG 2 and 2a LEPIDOMEDA VITTATA.
FIG 3 and 3a PLAGOPTERUS ARGENTISSIMUS. FIG 4 and 4a APOGON VULNERATA.

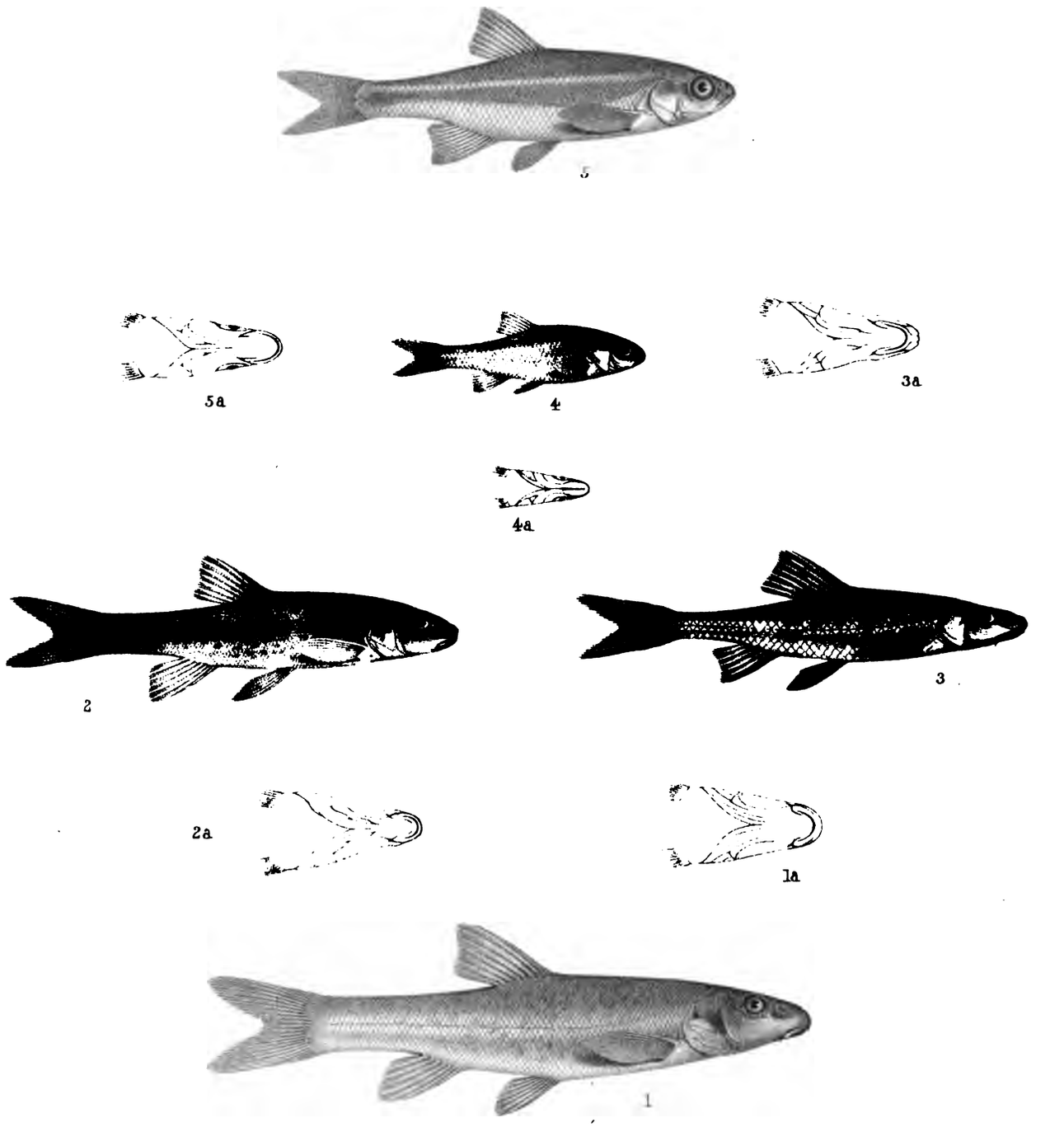

FIG. 1 and 1a RHINICHTHYS MAXILLOSUS. FIG. 2. and 2a. APOCOPE COUESI.
FIG. 3 and 3a CERATICHTHYS STERLETUS. FIG. 4 and 4a. GILA PHLEGETHONTIS.
FIG. 5 and 5a. GILA TÆNIA.

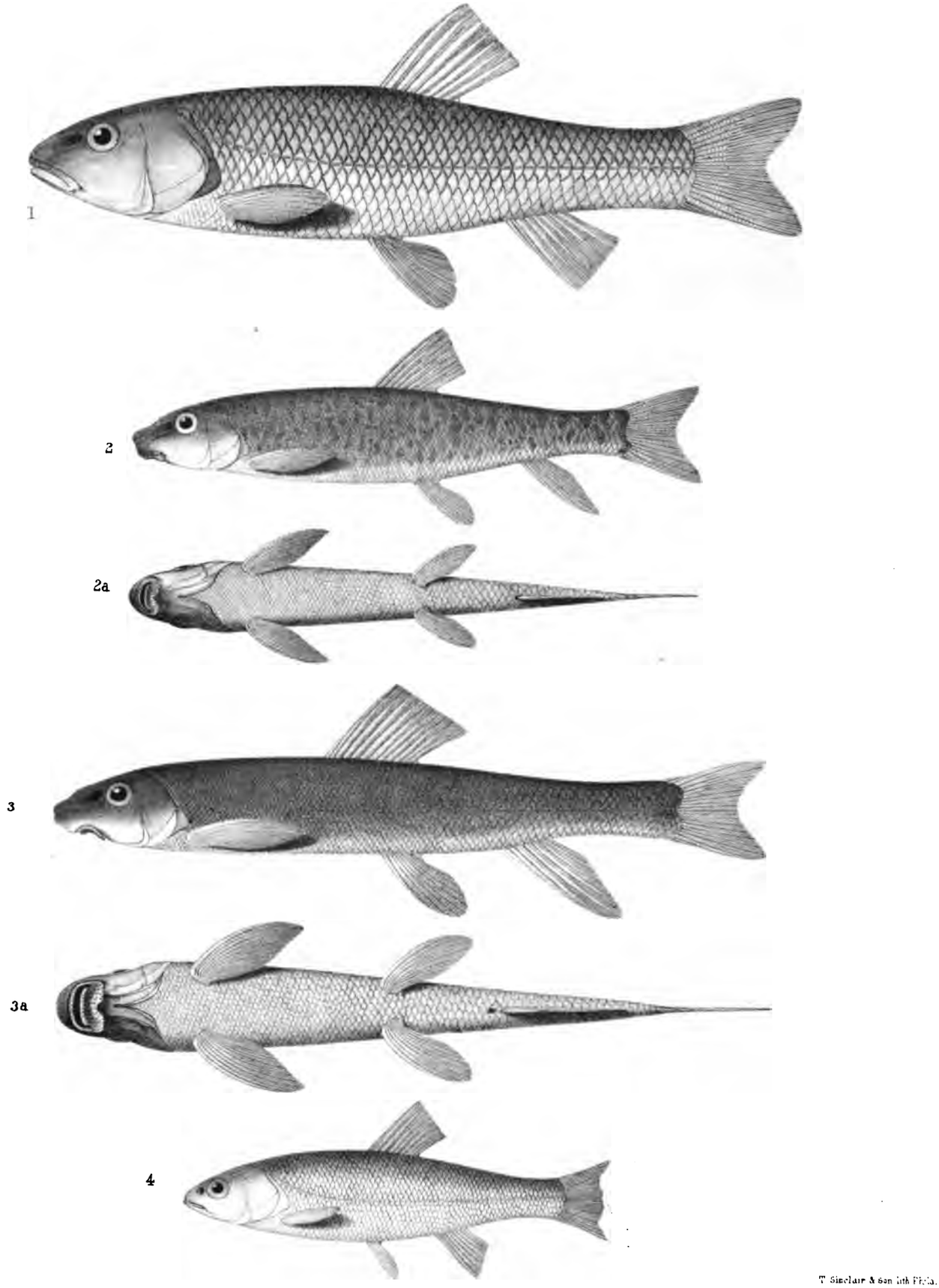

FIG. 1. CERATICHTHYS BIGUTTATUS. FIG. 2 and 2a PANTOSTEUS. JARROVII.
FIG. 3 and 3a. PANTOSTEUS PLATYRHYNCHUS. FIG. 4. SIBOMA ATRARIA VAR. LONGICEPS.

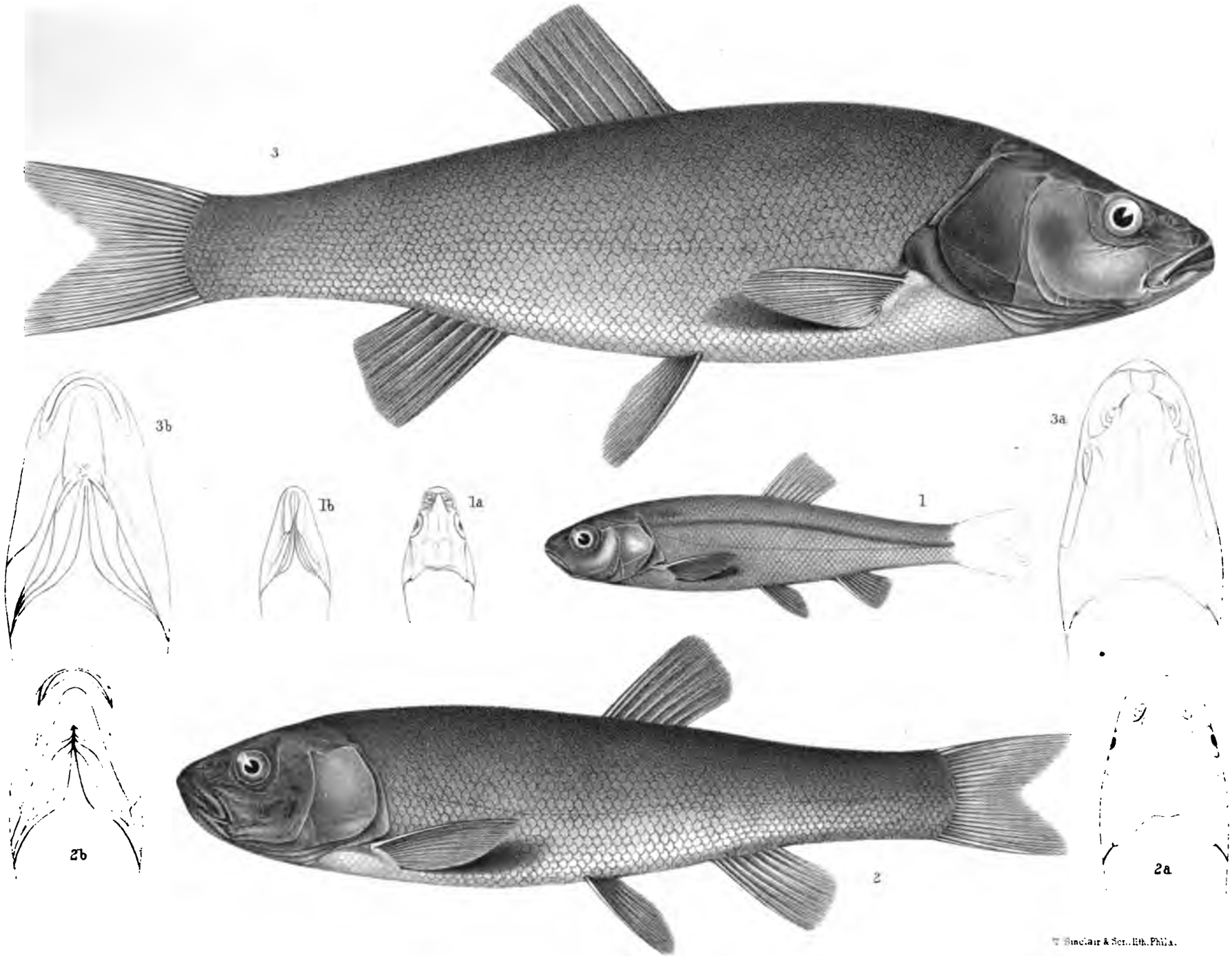

FIG. 1-1a. and 1 b. GILA ARDESIACA. FIG 2-2 a. and 2 b. GILA GULA. FIG. 3-3 a. and 3b GILA NIGRA.

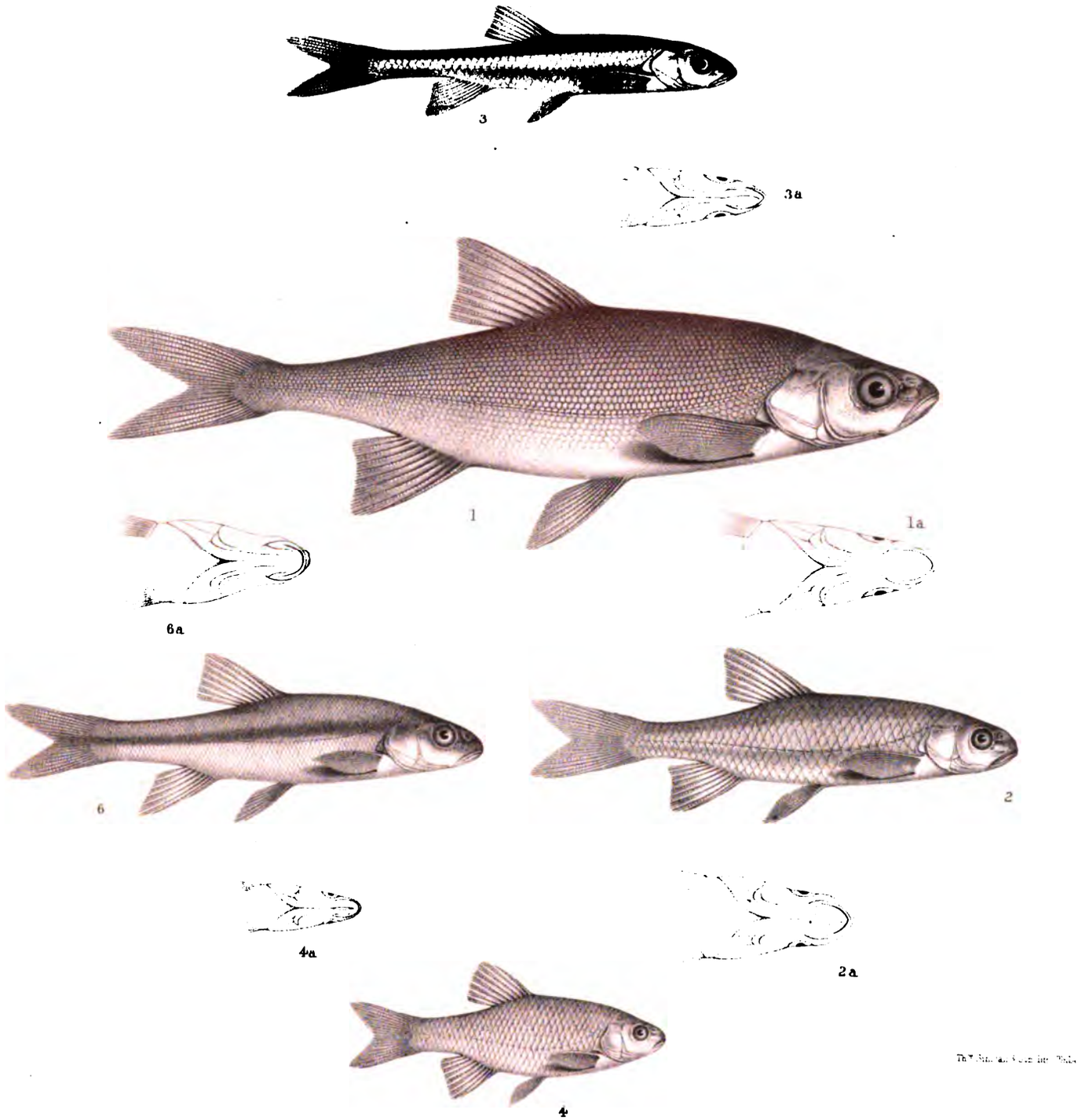

FIG 1 and 1a. GILA SEMINUDA FIG. 2 and 2a ALBURNELLUS SIMUS
FIG. 3 and 3a ALBURNELLUS JEMEZANUS. FIG. 4 and 4a HYPSILEPIS IRIS. &
FIG. 5 and 6a. HYBORHYNCHUS SIDERIUS.

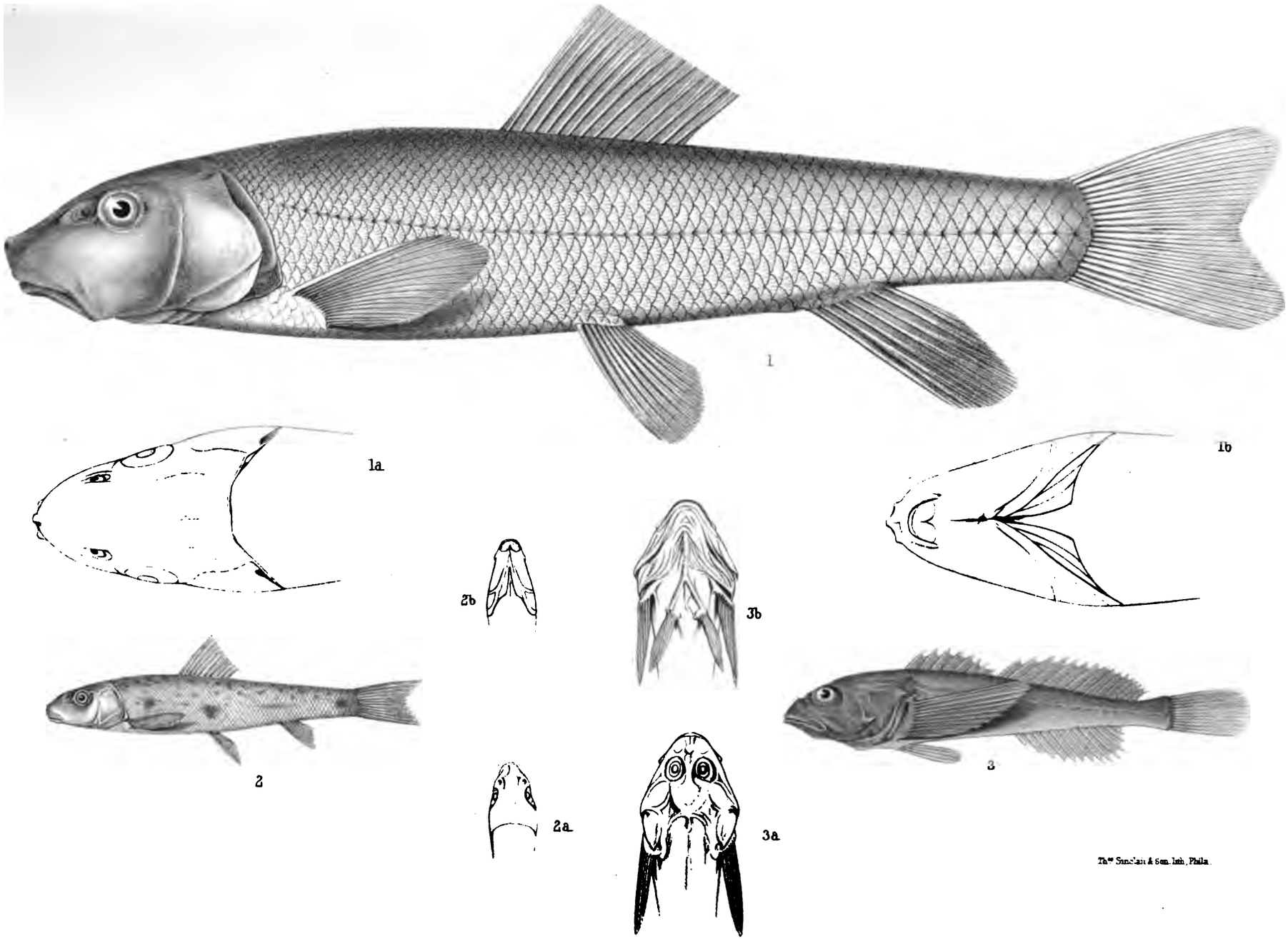

FIG. 1-1a. and 1b. CATOSTOMUS FECUNDUM : FIG. 2-2a. and 2b. MOXOSTOMA TRISIGNATUM
FIG. 3-3a and 3b. URANIDEA WHEELERI.

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